Intensive multiple-use forest management in Kerala

Forest Resources Development Branch
Forest Resources Division
Forestry Department

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PREFACE

Traditionally, the main objective of management of productive forest has been a sustained yield of commercial timber and problems in forestry have mostly been examined in this context. However, the evolution of forest management in the tropics has mainly been influenced by social, economic and political factors as a result of increasing populations and their needs for agricultural land to provide for these basic necessities. In view of this, it has become important to look for forest management options that not only will provide industrial timber but also other forest products that reflect the needs of the population living in or close to the forest.

In order to examine existing multiple-use forest management systems in the tropics, a series of studies were carried out under the auspices of FAO in various countries of Asia, Africa and Latin America during the years 1983 and 1984 and a synthesis of the findings is about to be published. However, the study from Kerala (India) is specially valuable because of the long history of forest management in this State and the efforts made to introduce truly multiple-use forest management. This study may help to clarify the complex issues of multiple-use forest management of tropical forests and it is why it is published herewith in its entirety. FAO wishes to acknowledge the excellent work carried out by the Kerala Forest Research Institute and by Dr. C.T.S. Nair in particular.

J.P. Lanly
Director
Forest Resources Division
Forestry Department

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SUMMARY

Growing awareness of the protective, productive and social functions of tropical forests has emphasized the need to develop appropriate systems for their management. An understanding of existing practices is essential to identify more viable systems of management. To gather necessary background information, the Food and Agriculture Organisation initiated case studies in four representative tropical regions. This report is an outcome of one such study and deals with the management of rainforests (evergreen forests) and teak plantations in Kerala State, India. The main findings are summarized below.

1. Kerala is the most densely populated State in the country. The per capita income of the State is lower than that of the rest of India.

2. Primary sector comprising agriculture, forestry, fisheries, etc., accounts for a major share of the net state domestic product.

3. The industrial sector is poorly developed and is dominated by agro-based industries.

4. Forests occupy about 24 percent of the geographical area of Kerala. All forests in the State are under public ownership.

5. Growing demand for land and products has led to the diversion of forest land for other purposes and this has progressively reduced the area under forests.

6. The two major types of forests that occur in the study area are evergreen forests and moist deciduous forests. Easily accessible evergreen forests are worked for wood production under a selective felling system. Moist deciduous forests are converted into teak plantations by clear-felling and they represent an extreme degree of modification.

7. Management practices adopted in the case of evergreen forests envisage watershed protection and wood production. To facilitate this, zoning is done by constituting working circles on the basis of marketability of species, accessibility, topography, etc. This zoning is primarily guided by short-term priorities.

8. Exploitable girth, felling cycle, number of trees prescribed for removal are worked out purely arbitrary without understanding the dynamics of the forest ecosystem. In the study area 8 to 12 trees/hectare above a girth of 180 cm are removed and the felling cycle has been fixed as 15 years.

9. Accessibility and demand seem to be the guiding factors that determine the intensity of selection system. Although nearly 30 species are listed for felling, in practice, a disproportionately large number of trees are removed from among the few species having high demand.

10. Natural regeneration is deficient in the evergreen forests. Despite specific prescriptions, efforts to promote regeneration get very little attention. The scheme of intensification of management taken up with the objective of augmenting regeneration covers only less than 5 percent of the felled area and the expenditure on this accounts for only 0.3 percent of the annual expenditure.

11. Areas which are inaccessible and which cannot be worked profitably are lumped together under protection working circle with the avowed objectives of securing watershed protection, soil conservation, etc.

12. With improvement in accessibility, area originally included under protection circle tends to shrink on account of its transfer to selection and sometimes conversion working circles.

13. Non-wood products obtainable from evergreen forests include reeds, canes and minor forest products. Present management attempts to regulate exploitation and no effort is made towards augmenting their future availability.

14. Although cardamom is cultivated in the evergreen forests for enhancing revenue, in the long run it adversely affects regeneration and leads to degradation of the forests.

15. Although watershed protection is mentioned as an objective in the working plans, no prescriptions exist and no definite steps are taken to enhance the protective values.

16. Most of the teak plantations have been established in areas which originally supported mixed moist deciduous forests which, although not as rich in plant diversity as the evergreen forests, contain a large number of commercially valuable species.

17. The mixed moist deciduous forests are converted into plantations of teak with the ostensible justification of increasing the value of the forests. However, very often such conversion seems to be motivated by the large revenue that can be realised during clear-felling.

18. Teak plantations are raised under the taungya system in which cultivators undertake all the post-planting operations for a period of about 2 years. Taungya reduces the cost of establishment, but causes site deterioration.

19. A rotation of 70 years is prescribed for teak plantations with the objective of producing quality logs. Thinning is carried out at the 4th, 8th, 13th, 20th, 30th and 44th years. The first two thinnings are systematic, while others are selective.

20. Both with and without taungya, teak plantations give a very high net present value, primarily due to (a) the low establishment cost, (b) early returns from thinnings and (c) high revenue from final felling on account of the steep price increment curve.

21. Converting moist deciduous forests into teak plantations represents a trend towards intensive single-use management.

22. Multiple-use management has been limited to the practice of taungya and the half-hearted attempts to raise cocoa and pepper. Both have failed to fulfil the objectives for which they have been introduced.

23. Analysis of objectives vis-à-vis achievement indicates that wood production and revenue maximisation get the highest priority, while watershed protection, although listed as the top priority in forest policies and working plans, is ignored in the actual management.

24. Divergence in the theory and practice of forestry can be attributable to the socio-political environment in which various groups and classes in society compete with each other for a larger share of the resources. Such a situation gives rise to constraints at the policy-making level, which, in turn, affects the institutions entrusted with the management of resources.

25. An explicit policy indicating priorities and trade-offs between incompatible uses is yet to be formulated.

26. The organisational structure of the forest department, which is the only institution directly involved in forest management, is inflexible and hence incapable of handling problems associated with intensive multiple-use management of forests.

27. The existing trend indicates that single-use management is growing in importance, especially in the wake of industrial orientation of forestry in the country.

28. Considering the population pressure and the diversity of demands, multiple-use management of forests is inevitable.

29. Practice of multiple-use forestry requires (i) the existence of a clear cut policy identifying the social priorities and trade-offs between mutually exclusive options, (ii) creation of appropriate institutions and (iii) technical improvement in forestry through research.

30. While judging the desirability of multiple-use systems, it is necessary to look into their social implications. In a developing country, where poverty is pervasive, multiple-use management should be directed at meeting the basic needs.

INTRODUCTION

Increasing awareness of the multivarious functions of tropical forests has highlighted the need to develop appropriate systems for their management. Failure to do so will lead to rapid deforestation and eventual disappearance of these valuable forests. The burgeoning demands and the high density of population make it necessary to develop intensive multiple-use management systems. This, however, requires a good knowldege of existing practices and their deficiencies in fulfilling different objectives. To gather the necessary background information, the Food and Agriculture Organisation initiated case studies in representative tropical regions. The report presented here is the outcome of such a study undertaken in Kerala, India.

For two reasons, the case study on forest management in Kerala has added relevance. Firstly, forestry has a long history and attempts have been made to systematically manage the forests during the last few decades. Secondly, Kerala is a typical less developed region characterised by high population density and forest management has to face complex socio-economic problems. The experience of Kerala in forest management could be relevant to countries or regions in similar situations.

Objectives of the Study

The broad objective of the case study is to give an account of the existing systems of management as applied to the rainforests (evergreen forests) and teak plantations in the State. Specifically its aims are:

(1) to describe the present management practices adopted in the case of evergreen forests and teak plantations,

(2) to critically examine the appropriateness of these practices, and

(3) to indicate future options as regards intensive multiple-use management in the study area and the State as a whole.

Plan of Study

The report is presented in eight chapters. Chapter 1 gives the background information pertaining to Kerala, focusing attention on the demographic situation, land use pattern, industrial development, forestry and wood-based industries. For a detailed analysis of existing systems of forest management covering both rainforests (evergreen forests) and teak plantations, Quilon District, one of the most forested areas in the State, was chosen as the study area. Chapter 2 gives a detailed description of Quilon District. The existing forest management is an outcome of historical factors and development of forestry has to be correlated to social, economic and political changes. Such an attempt is made in Chapter 3.

A general description of forest management in the State is given in Chapter 4. Important issues related to policy formulation, planning, implementation, etc., are discussed here. Chapter 5 gives details of the management of evergreen forests, the most important vegetation type in the study area. Management of moist deciduous forests and teak plantations is dealt with in Chapter 6. A critical evaluation of existing systems of

management is given in Chapter 7. Here an attempt is made to identify the social, institutional, technical and financial constraints in forest management. The concluding Chapter discusses the likely future trends in forestry in Kerala and indicates briefly the priorities if appropriate systems of intensive multiple-use management are to be evolved.

CHAPTER 1

KERALA: THE BACKGROUND

1.1 Location and Locality Factors

Kerala State, formed during the reorganisation of Indian States in 1956, comprises the erstwhile princely States of Travancore and Cochin, and parts of the Malabar and South Canara Districts of the Madras and Bombay Presidencies respectively of the British India (Fig. 1.1). It is situated between $8^{o}17'$ and $12^{o}47'$ North, and $74^{o}51'$ and $77^{o}24'$ East and is a narrow coastal strip bounded by the Western Ghats on the East and Arabian Sea on the West. The geographical area of the State is 3.8 million hectares. The climate is equable and typically tropical. Temperature varies from $35^{o}C$ in April to about $20^{o}C$ in January. The high range region above 1 800 metres experiences much lower temperature and frost is common in protected valleys. The mean annual rainfall is about 3 000 mm. Almost 60 percent of the precipitation is obtained from the South-West monsoon during June to August and the rest mainly from the North-East monsoon during the months of September to November.

Based on altitude three broad natural regions have been recognised as given in Table 1.1 (Fig. 1.2).

The coastal lowland region is densely populated and agriculture and allied activities are the principal occupation of people. Forests are found mostly in the midland and highland regions.

Table 1.1

Natural Regions in Kerala

Region	Elevation (m)	Area (in sq. km)	Percentage of total geographical area
Lowland	< 7.62	3 979.0	10.2
Midland	7.62 to 76.2	16 231.5	41.8
Highland	76.2 and above	18 653.5	48.0

Source: Land Use Board (1980)

Socio-economic Conditions

1.2.1 Population

Kerala is the most densely populated State in India. Table 1.2 gives the total population and density for the State and the country.

Fig. 1:1. CONSTITUENTS OF KERALA STATE

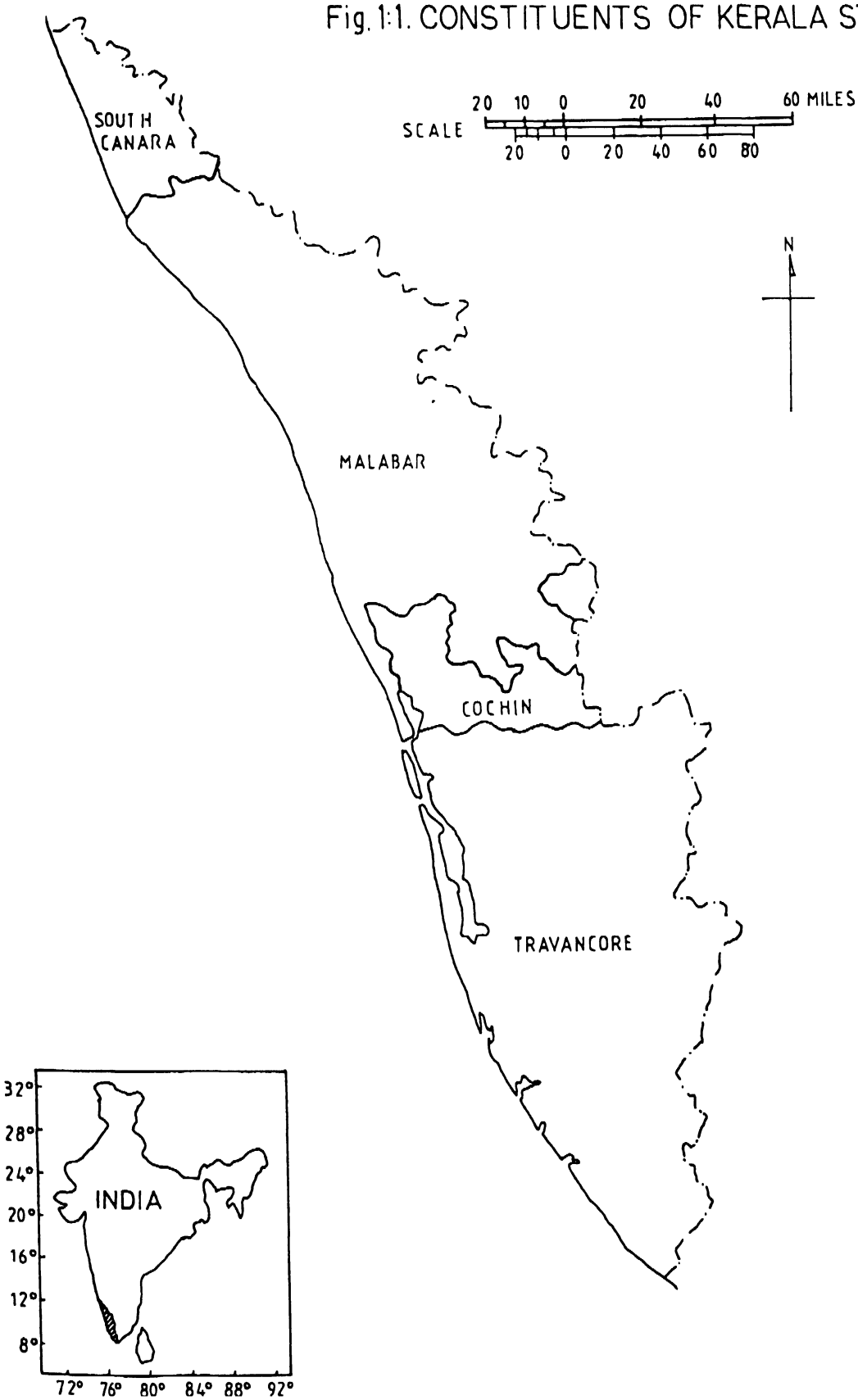


Fig 1.2

KERALA

NATURAL DIVISIONS

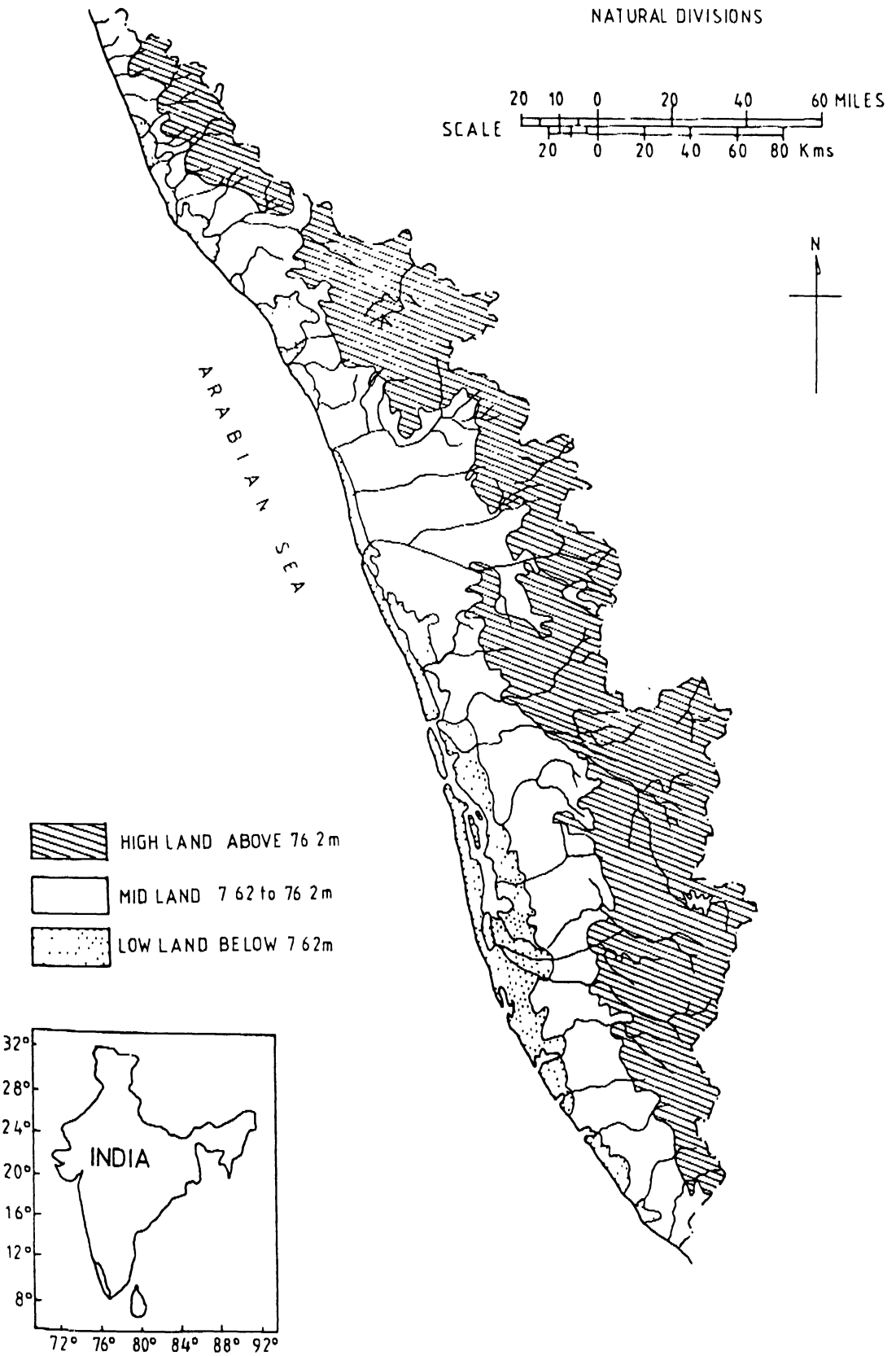


Table 1.2

Population in Kerala and India

Year	Kerala		India	
	Population (in million)	Density (No./km^2)	Population (in million)	Density (No./km^2)
1951	13.55	349	361.09	117
1961	16.90	435	439.23	142
1971	21.38	549	548.16	177
1981	25.40	654	685.18	216

Source: Government of India (1971, 1981)

In some of the coastal areas the density is over 2 000 persons/km^2. The high population density is an important factor to be considered in resource planning.

1.2.2 State Income and per capita Income

The state domestic product (SDP) of Kerala for the year 1980-81 has been estimated as Rs. 33 140 million (Government of Kerala, 1982). At 1970-71 prices, the increase in state domestic product during the decade 1971-81 was 24.1 percent while the decennial growth rate of population was 19 percent. Per capita income for Kerala and India is given in Table 1.3.

Table 1.3

Per capita income - Kerala and India, 1980-81

(in Rs.)[1/]

	Kerala	India
At current prices (1980-81)	1 311.0	1 571.0
At constant prices (1970-71)	589.8	700.0

Source: Government of Kerala (1982)

1/ The currency used is Indian Rupees. At current exchange rates the equivalent is US$ 1 = 10.78 Rs.

1.2.3 Employment

An outcome of population increase and slow expansion of the agricultural and industrial sectors is the high unemployment in the State. In 1980 the number of work seekers registered with the employment exchanges was 2.06 million (Govt. of Kerala, 1982). This, however, represents the educated unemployed, and when the number of those not registered with the employment exchanges is also considered, the unemployment situation is alarming. Further, due to the seasonal nature of agricultural operations and the smaller size of land holdings, under-employment and disguised unemployment also exist.

1.2.4 Other Indicators of Development

An indicator like *per capita* income has serious limitations in reflecting the overall level of development. The Physical Quality of Life Index (PQLI) derived on the basis of life expectancy at birth, infant mortality and literacy rate is being used for the purpose of comparison. Table 1.4 gives different values for Kerala and India.

Table 1.4

Indicators of Physical Quality of Life

Indicator	Kerala	India
1. Literacy rate - percentage	70	36
2. Infant mortality - per 1 000	42	127
3. Life expectancy at birth	65	51

Source: Govt. of Kerala (1980, 1982)

Evidently, performance of Kerala in terms of the above indicators is outstanding and is often highlighted to indicate that reasonably good standards can be achieved in a low income situation (World Bank, 1980). Public investment in health, education, transport and communications has been very high. Kerala has an extensive network of medical institutions. The *per capita* public expenditure on health and education has been consistently higher than that of the rest of India. A major share of investment in education has gone for primary and secondary levels.

1.2.5 General Features of the Economy

The sectoral allocation of net state domestic product (SDP) for 1970-71 and 1980-81 is given in Table 1.5.

Table 1.5

Distribution of State Domestic Product at 1970-71 Prices

Sector	1970-71		1980-81	
	Value (Rs. in million)	Percentage	Value (Rs. in million)	Percentage
1. Primary	6 203.00	51.7	6 235.6	41.8
2. Secondary	2 048.10	17.1	3 062.2	20.6
3. Tertiary	3 751.10	31.2	5 602.9	37.6
Total	12 002.20	100.0	14 900.7	100.0

Source: Govt. of Kerala (1982)

During the last decade the share of primary sector (comprising agriculture, forestry, fisheries and mining and quarrying) has declined considerably, partly due to the growth of other sectors and partly due to the poor performance of the agricultural sector. Also, inflow of foreign remittance has led to the rapid expansion of activities in the tertiary sector, especially transport, banking, etc. The industrial sector is dominated by traditional agro-based industries. By and large Kerala remains an industrially backward region. The industrial sector employs about 1.08 million workers and 80 percent of this is accounted by small-scale and cottage industries. About 81 percent of the population live in rural areas.

1.3 Land Use Pattern

The land use pattern in Kerala is given in Table 1.6.

Table 1.6

Land Use Pattern in Kerala

Use	Percentage of the total
1. Forest	27.8
2. Agriculture (net area sown)	56.1
3. Non-agricultural uses	6.9
4. Barren and uncultivated	2.3
5. Grazing land	0.1
6. Land under miscellaneous crops	1.7
7. Cultivable waste land	3.3
8. Fallow	1.8
Total	100.0

Source: Govt. of Kerala (1982)

The land use pattern has been undergoing conspicuous changes and with gradual urbanisation, area utilised for non-agricultural use has increased considerably (Land Use Board, 1981). Within the agricultural sector there has been a shift from annual and seasonal crops to perennial crops. This is particularly conspicuous in the paddy growing areas, which are being converted into coconut gardens (Unni, 1983). The extent of forests has declined and statistics furnished by different agencies are not reconcilable. This aspect is discussed later.

1.3.1 Area under Principal Crops

The allocation of agricultural land for different crops in the State is given in Table 1.7.

Table 1.7

Area Under Important Crops

Crop	Area (in ha)
Rice	806 918
Coconut	652 897
Rubber	248 000
Tapioca	243 563
Cashew	142 366
Pepper	108 073
Arecanut	61 545
Coffee	57 949
Cardamom	56 376
Banana and plantains	49 262
Tea	36 164
Pulses	32 453
Sesamum	14 571
Ginger	12 585
Ground nut	9 399
Sugarcane	8 016
Cotton	6 223
Sweet potato	5 090
Turmeric	3 250
Ragi	1 471

Source: Govt. of Kerala (1982)

A general view of the land use pattern in Kerala: Irrigated rice cultivation and coconut gardens on the fringes of denuded hills.

Habitation on forest fringes. The valleys are used for irrigated rice cultivation.

In terms of area and value of production, the agriculture sector is dominated by cash crops and consequently the State is an importer of food grains, especially rice and wheat. In the recent years production and productivity of important crops such as rice and coconut are showing a declining trend (Pillai, 1982). There has been a reduction in the area under high-yielding varieries and their general performance has been far from satisfactory. Root wilt disease of coconut has been primarily responsible for decline in its production and research is yet to identify effective remedial and preventive measures against the disease.

1.4 Forestry: An Overview

1.4.1 Area under Forests

The area under forests has been estimated differently by various agencies as given in Table 1.8.

Table 1.8

Forest Area in Kerala

Source	Area (km^2)	Pertaining to year	Percentage to the geographical areas
1. Administration Report of the Forest Department 1/	11 279.6	1978-79	29.0
2. Revenue records 2/	10 815.0	1978-79	27.8
3. Resource Survey of Forest Department 3/	9 400.0	1970	24.2

Source: 1/ Govt. of Kerala (1981)

2/ Govt. of Kerala (1980b)

3/ Chandrasekharan (1973)

The discrepancy arises primarily due to the difference in the criteria followed for defining forests. The records of the Forest Department follow the legal definition and include all areas which are constituted as reserved forests under the Kerala Forest Act. Although in many instances forests have been diverted for non-forestry purposes, on account of delay in completing formalities for disreserving them, they continue to be accounted as forests. Therefore, for all planning purposes, the estimate furnished by the resource survey of 1970 is being used now, despite its outdatedness.

1.4.2 Ownership

All forests in the State are under public ownership. Prior to 1971, private ownership of forests existed, especially in the Malabar region. About 1 900 km^2 of forests were under the ownership of feudal landlords. In 1971, the Government took over these forests without paying any compensation.

1.4.3 Forest Types

Variation in rainfall and altitude has contributed to the floristic richness of forests in the State. They fall under the broad category of tropical moist forests and are grouped under the Indo-Malayan rainforest formation (Whitmore, 1975). Considerable variation in structure, composition, etc., is noticed within this broad type and due to its aseasonal nature the main Indo-Malayan formation is richer in species diversity than the forests in the Western Ghats. Important forest types in Kerala and their area are given in Table 1.9.

A detailed description of the major forest types found in the State is given in Chapter 2.

Table 1.9

Forest Types in Kerala

Type	Area (km^2)
1. Evergreen and semi-evergreen forests	4 750
2. Moist deciduous forests	2 746
3. Dry deciduous forests	170
4. Montane subtropical and temperate forests	160
5. Man-made forests	1 574
Total	9 400

Source: Modified from Chandrasekharan (1973)

Plantation forestry has a fairly long history in the State and dates back to the 1840s when teak planting commenced in the Nilambur valley. Up to about 1960, teak continued to be the principal plantation species. Eucalyptus came to the fore-front when demand for pulpwood increased considerably and bamboo resources were found to be insufficient. The extent of plantations under important species is given in Table 1.10.

As per the resource survey (Chandrasekharan, 1973), about 32 percent of the teak plantations are of site quality II and above while the rest are of quality III and quality IV. Indiscriminate extension of plantations into less fertile areas has increased the proportion of low quality plantations. In certain areas in Nilambur division, two rotations of teak have been completed and planting has been done for the third rotation. Teak, although a hardwood and unsuitable for the match industry is a major component in matchwood plantations and sometimes account for about 75 percent of the total number at the time of planting. Other species raised in mixtures as matchwood plantations are Bombax ceiba, Ailanthus triphysa and Euodia lunu-ankenda.

Large-scale planting of eucalyptus commenced in Kerala during the 1960s. The two important species are Eucalyptus tereticornis and E. grandis. At the time of their initial introduction they were primarily used for afforestation of degraded forests and grasslands. The growing demand for pulpwood has been primarily responsible for large-scale cultivation of eucalyptus in clear-felled moist deciduous and evergreen forests.

Table 1.10

Man-made Forests in Kerala[1/]

Species	Area (ha)	Percentage to the total
1. Teak	76 927	49.6
2. Eucalyptus	38 131	24.6
3. Matchwood	23 827	15.4
4. Others[2/]	16 277	10.4
Total	155 162	100.0

1/ (As on 31.3.1982)

2/ Includes rosewood, balsa, wattle, bamboo, cashew, mahogany, pepper, silver oak, coffee, albizia, rubber, etc.

Source: Karunakaran (1982)

The annual rate of planting in the State during different periods is given in Table 1.11. Nearly 70 percent of the man-made forests in the State were raised after 1960.

Table 1.11

Annual Planting Programme in Kerala

Period	Average Annual Planting (area in hectare)
1956-57 to 1960-61	2 990
1961-62 to 1965-66	5 060
1966-67 to 1970-71	5 726
1971-72 to 1975-76	5 050
1976-77 to 1981-82	4 711

Source: Records of the Forest Department

1.4.4 Growing Stock

As per the resource survey carried out in 1970, the total growing stock of timber in Kerala forests has been estimated as 185 million m^3. Of this 30 million m^3 is in the private forests which now vest with the Government. Distribution of the growing stock in government forests under different utilisation categories is given in Table 1.12.

Considering the forest land use changes that have taken place since 1970, the growing stock now available will be far less than that given in Table 1.12. Removal of old growth and its replacement by plantations also would have reduced the growing stock considerably.

No information is available on non-wood resources, especially minor forest products, medicinal plants, etc.

Table 1.12

Growing Stock of Wood in Different Utilisation Categories

Category	Growing stock (in million m^3)
Plywood	16.74
Matchwood	2.85
Pulpwood	3.01
Other industrial wood	49.75
Fuelwood	82.62
Total	154.97

Source: Chandrasekharan (1973)

1.4.5 Yield

Recorded yield of timber and other products from the forests of Kerala is given in Table 1.13.

Table 1.13

Yield of Timber and Other Products

Year	Timber (m^3)	Firewood (tons)	Poles (No.)	Charcoal (bags)
1960-61	224 560	179 383	252 349	Nil
1965-66	446 432	163 255	251 019	103 172
1970-71	517 440	280 069	368 081	643 415
1975-76	501 429	225 043	1 148 969	12 522
1978-79	447 495	304 683	1 387 450	151 801

Source: Kerala Forest Department (1978)

It must be emphasized that this represents the recorded removals only. Especially in the case of firewood, a large quantity is collected by people living adjacent to forest areas, both for domestic consumption and for petty trade.

1.4.6 Revenue and Expenditure of the Forest Department

Revenue and expenditure of the Forest Department for different years are given in Table 1.14.

Table 1.14

Revenue and Expenditure of the Forest Department (in million Rs.)

Year	Revenue	Expenditure	Surplus	Surplus at 1970-71 prices
1975-76	219.20	73.38	145.82	84.34
1976-77	261.75	76.89	184.86	104.68
1977-78	317.84	76.79	241.05	129.88
1978-79	350.62	83.45	267.17	143.87
1979-80	440.42	93.92	346.50	159.24
1980-81	457.29	121.62	335.67	130.46
1981-82	539.40	132.00	407.40	145.19

Source: 1. Kerala Forest Department (1978); 2. Govt. of Kerala (1982)

Increase in net revenue at constant prices is partly due to increase in real price of timber and firewood and partly due to increase in their out-turn. No attempt has been made to estimate the quantity effect and price effect separately.

1.4.7 Contribution of Forestry to State Domestic Product

Table 1.15 gives the contribution of forestry and logging to the net state domestic product (SDP) for different years.

Table 1.15

Contribution of Forestry Logging to State Domestic Product

Year	Proportion of SDP from forestry (in percentage)
1975-76	1.0
1976-77	0.9
1977-78	0.8
1978-79	0.7
1979-80	0.6
1980-81	0.7

Source: Govt. of Kerala (1982)

It can be seen that the share of forestry towards the state domestic product has declined considerably over the years indicating that growth of the sector has been lagging behind the rest of the economy.

1.4.8 Wildlife Management

The floristic diversity has contributed to the rich and varied fauna of the State. Important species found in Kerala are elephant, gaur, sambar, spotted deer, barking deer, wild boar, panther, bear, etc. The avifauna is also extremely rich. There are seven wildlife sanctuaries with a total area of 1 822 km^2. Although wildlife management is the principal objective, other activities such as collection of bamboo, reeds, minor forest products and extraction of timber are permitted in the sanctuaries. Habitat destruction and poaching are the major problems in wildlife management and even sanctuaries are not free from these.

1.4.9 Wood Resources of Non-forest Areas

Agricultural land and plantations form an important source of timber and firewood in Kerala. Most homesteads are characterized by intensive multiple cropping with a large number of tree species such as coconut (Cocos nucifera), arecanut (Areca catechu), cashew (Anacardium occidentale), rubber (Hevea brasiliensis), jack (Artocarpus integrifolia), tamarind (Tamarindus indicus), anjili (Artocarpus hirsuta), neem (Azadirachta indica), matti (Ailanthus triphysa), jamum (Syzygium cuminii), bamboo (Bambusa arundinacea), etc. A major part of the timber and firewood requirements of households are met from these. Rubberwood obtained from plantations is an important input in the packing case industry in the State. A large number of the matchwood units depend on matti wood grown in house compounds. The growing demand for matchwood has resulted in its cultivation in the garden lands and house compounds. With the increase in timber prices coconut wood is becoming more popular for house construction.

No data is available on the quantity of timber and firewood obtainable from non-forest sources. A major portion is utilised for household consumption and therefore do not reach the market place. There are indications that the stock of wood other than that from plantation crops such as coconut, arecanut, rubber, etc. is declining rapidly. Poverty of the small holders coupled with the increasing demand for timber and firewood has led to the clearance of miscellaneous trees in house compounds either to meet household consumption needs or to augment family income.

1.4.10 Export and Import of Timber

A large quantity of timber and firewood is exported to the neighbouring wood-deficit states, particularly Tamil Nadu. No estimate is available on the quantity thus supplied. Data collected from registers maintained at border check posts indicate that in certain years such exports amounted to more than 50 percent of the recorded removal from government forests.

The high prices prevailing in Kerala markets have led to the import of certain species having good local demand from states like Orissa and Andhra Pradesh. Despite the high transport cost, the low prices prevailing at the place of origin enable the traders to realise a high margin.

No appreciable quantity of timber is being exported abroad from Kerala. Export of logs of teak and rosewood has been banned to encourage local processing.

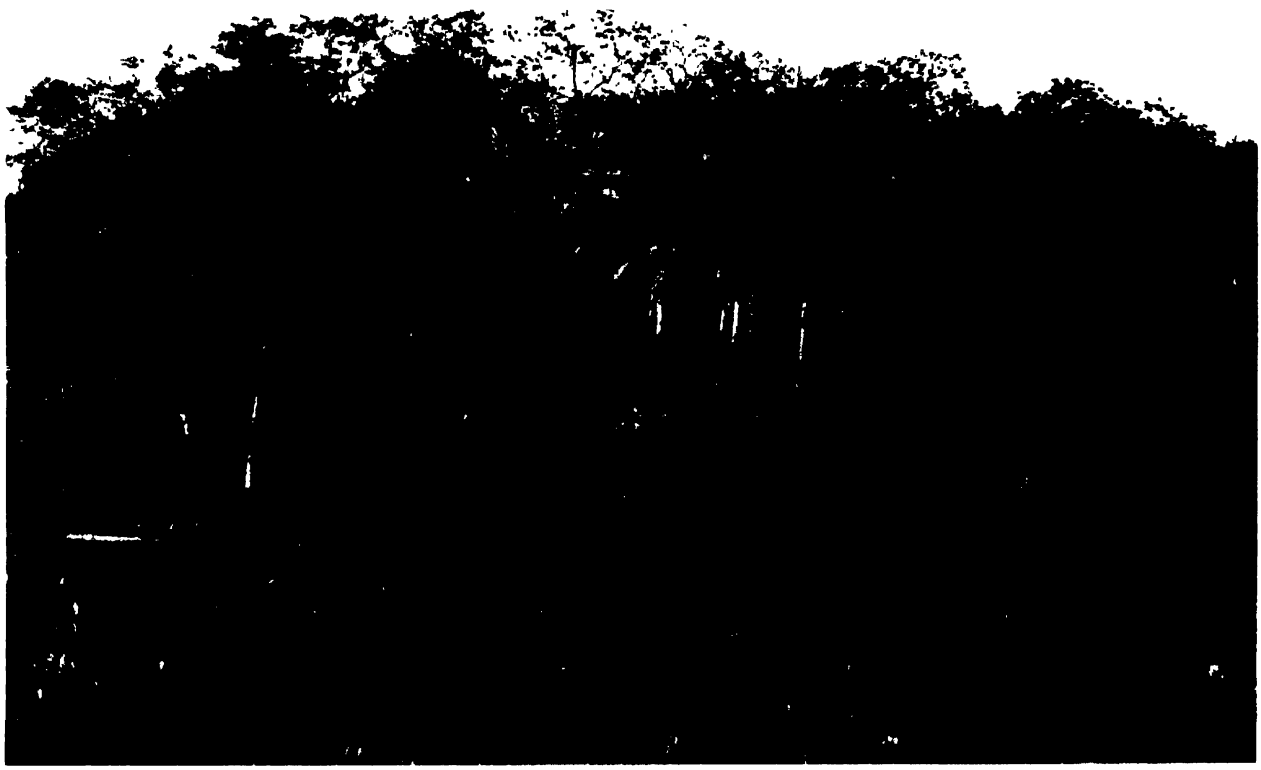
1.5 Forest-based Industries

The forest industries sector is dominated by primary processing units. There is a preponderance of small-scale units, especially in the matchwood, plywood and saw mill industries.

1.5.1 Saw Mill Industry

Saw-milling is probably the most important wood using industry in the State. In 1982 there was 1 024 registered saw mills. The total number of persons employed in the industry is 6 980. Large saw mills are concentrated in timber trading centres and a majority of them came up when there was a sudden spurt in wood production consequent on the large-scale clear-felling of forests. Most of the units located in rural areas operate for only a few hours and carry out sawing of small consignments brought by customers. A major portion of the output goes into the construction sector and the rest to transport equipment, packaging, agricultural implements, etc.

Mixed cropping in homesteads (jack - with fruits, coconut, arecanut, mango, cocoa, banana).



Homestead cultivation on forest fringes (tapioca, banana, coconut, jack, rubber).

1.5.2 Plywood

There are 81 plywood units with a total installed capacity of about 18.6 million m^2 (4 mm thickness) and Kerala accounts for about 18 percent of the total production of plywood in the country. Although initial establishment and growth of the industry was closely linked to the tea industry by way of supply of packing cases, now most of the units produce commercial and decorative plywood. The industry is facing acute shortage of quality veneer logs and the quantity supplied by the forest department is not even sufficient to enable 50 percent capacity utilisation. Unplanned growth of installed capacity has been primarily responsible for the demand-supply imbalance. To overcome this, some of the units are procuring wood from sources outside the State, especially Karnataka and Andaman Islands.

1.5.3 Match Industry

Match industry in Kerala is dominated by small-scale units. In 1982 there were 144 registered match units in the State employing about 2 000 workers. Most of the units produce box veneers and splints and export them to the dipping units in Tamil Nadu. The annual wood requirement of the match industry is 1,30,000 m^3. However, supply of wood from forest department is less than 10 percent of the requirements. Part of the deficit is met from farm lands and homesteads. As in the case of plywood industry, the imbalance in demand and supply of wood is primarily attributable to unplanned growth in capacity disregarding raw material availability.

1.5.4 Pulp and Paper Industry

There are three pulp and paper units producing industrial and cultural paper, rayon pulp and newsprint. Initially most of the units were dependent on locally available long fibre raw material, namely, bamboo and reed. Declining availability of bamboo and reed has necessitated use of hardwood species, and large-scale eucalyptus cultivation is an outcome of this. In the pulp and paper industry also, installed capacity has been increased without due consideration for sustained availability of raw material leading to demand-supply imbalance.

1.5.5 Other Industries

There are a number of other forest-based industries manufacturing furniture and fixtures, pencils, bobbins, wooden toys, handicrafts, etc. Most of these are in the household sector, and hence no data is available on production and employment.

Reed-and bamboo-based cottage industries employ about 300 000 workers and produce utility items such as baskets, mats, and wall hangings. The industry provides livelihood to the socially and economically backward sections in society. The Kerala State Bamboo Corporation, a public sector undertaking, organises supply of reeds to all the traditional users in the Travancore and Cochin regions. There are a large number of cooperative societies involved in reed industry. Availability of reeds has declined considerably due to diversion of forest land for non-forestry purposes and conversion of natural forests into plantations. Increased demand from the pulp and paper industry has also adversely affected reed supply to the traditional sector.

1.6 Summary and Conclusions

Kerala is a typical under-developed tropical region characterized by high population density, low per capita income and general economic backwardness. Unemployment situation in the State is precarious. However, in terms of indicators of physical quality of life, Kerala is far different from the rest of the country and the level achieved is comparable to that of the middle income countries. The equable tropical climate permits the cultivation of a large number of agricultural crops and this complicates land use decision-making. The industrial sector is dominated by agro-based industries which directly and indirectly influence land use.

The forests in the State come under the broad category of tropical moist forests and the most predominant types are wet evergreen forests and moist deciduous forests. Man-made forestry has a very long history in the State and plantations of various species account for about 16 percent of the forest area. However, the contribution of forestry to the net state domestic product is very low. Apart from its productive functions, forests have important protective functions which are of great consequence in a predominantly agrarian economy such as that of Kerala. Clearly, the situation in Kerala appears to be apt for a detailed case study.

CHAPTER 2

THE STUDY AREA

In order to identify the various issues involved in forest management, an area-specific study is essential. The present study is, therefore, restricted to Quilon District, part of the erstwhile Travancore State. Existence of large-scale teak plantations and extensive evergreen forests has been an important consideration that led to the choice of Quilon District. This chapter gives the background information on the study area focusing attention on forests and forestry in the district.

2.1 Locality Factors

The district lies between $8^{o}45'$ and $9^{o}27'$ North latitude and $76^{o}29'$ and $77^{o}17'$ East longitude (Fig. 2.1). The total geographical area of the district is 4 743 km^2 and it is the second largest district in the State 1/. It is bounded on the East by the Western Ghats and on the West by the Arabian Sea. The elevation varies from sea level to 1 920 m. There are several hill ranges exceeding an elevation of 1 500 m. Towards the Southern side, elevation on the Western Ghats declines and there are two important passes. The road and railway line connecting the State and the District with the adjoining State of Tamil Nadu pass through the Aryankavu gap and this has considerable significance as far as forests and forestry in the region are concerned.

Based on physical features three natural regions can be identified, namely: (1) lowland, (2) midland, and (3) highland. Distribution of area under the different taluks in the district among these geographical regions is given in Table 2.1.

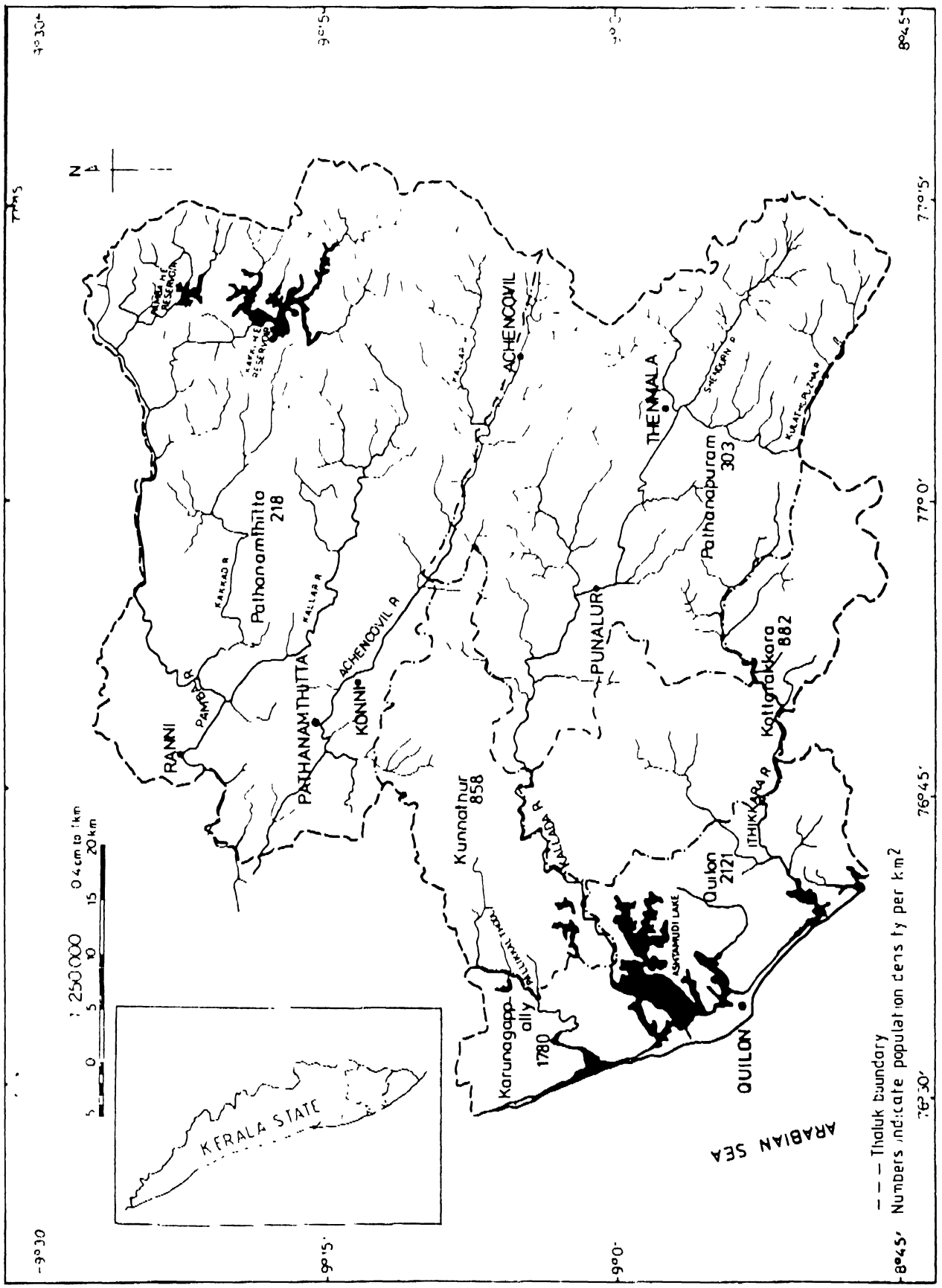
The lowland region, situated near the coast is characterized by paddy fields, coconut gardens and backwaters. The midland region primarily consists of hills and valleys and the terrain is gentle to moderately slopping. In contrast, the highland region is rugged with steep slopes. Most of the forests are located in the highland region. Several rivers originating from this region and flowing West, divide the district into distinct river basins. Pamba, Achenkovil and Kallada are the main rivers in the study area.

The climate is typically tropical characterized by high rainfall, high humidity and high temperature. The normal annual rainfall is 2 760 mm and this is obtained from both the South-West monsoon (June to August) and North-East monsoon (September to November). Some of the interior forest areas receive a rainfall of over 5 000 mm. Although the average rainfall is less than that of the State, it is more well-distributed and the average number of rainy days is more than the Northern parts of the State. The temperature varies from $25^{o}C$ to $35^{o}C$.

2.2 Population

The population in Quilon District is 2.81 million and the density is 608 km^2. Considerable difference is noticed in the density of population between different regions. In the coastal taluk of Quilon, it is as high as 2 120 per km^2, while in the highland

1/ Recently a new district has been carved out from Quilon District consisting mostly of the Pathanamthitta Taluk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KALLADA R
ACHENCOVIL R
KONNI
ACHENCOVIL
PUNALUR
THENMALA
Pathanapuram
303
Kottarakkara
882
Kunnathur
858
Karunagappally
1780
Quilon
2121
ITHIKKARA R
ASHTAMUDI LAKE
QUILON
ARABIAN SEA
--- Thaluk boundary
Numbers indicate population density per km²
9°30'
9°15'
9°00'
8°45'
76°30'
76°45'
77°0'
77°15'

Table 2.1

Area Under Different Natural Regions in Quilon District[1/]

Taluk	Area (km^2)			
	Lowland	Midland	Highland	Total
1. Karunagappally	192.22 (90.7)	19.70 (9.3)	..	211.92 (100.0)
2. Quilon	163.19 (42.9)	217.02 (57.1)	..	380.21 (100.0)
3. Kunnathur	..	302.96 (77.7)	86.97 (22.3)	389.93 (100.0)
4. Kottarakkara	..	551.60 (100.0)	..	551.60 (100.0)
5. Pathanamthitta	..	174.87 (8.8)	1 800.67 (91.2)	1 975.54 (100.0)
6. Pathanapuram	..	146.12 (11.8)	1 087.54 (88.2)	1 233.66 (100.0)
Quilon District	355.41 (7.5)	1 412.27 (29.8)	2 975.18 (62.7)	4 742.86 (100.0)

1/ Figures in parentheses give the percentage.

Source: Land Use Board (1980)

taluk of Pathanamthitta it is only 218 per km^2 (Govt. of India, 1981). The growth rate of population during 1971 to 1981 was 16.35 percent and is lower than the growth rate for the State as a whole. The forested taluks of Pathanamthitta and Pathanapuram registered decadal growth rate of 10.17 percent and 20.15 percent respectively.

As per the 1981 census, workers account for only 24.4 percent of the total population. This is due to the very low proportion of workers from among women who account for about 51 percent of the population. Agriculture is the main occupation, especially in the midland and highland taluks. Cultivators and agricultural labourers constitute 45 percent of the total workers. As in the case of the rest of Kerala, unemployment is very high. Eighty four percent of the land holdings is less than one hectare, and the average size of a holding is only 0.60 hectare. Under-employment is therefore a common feature in the agricultural sector, and this directly and indirectly influences forest land use.

2.3 Land Use

The land use pattern as per the revenue records is given in Table 2.2.

Table 2.2

Land Use in Quilon District

Use	Area (km^2)	Percentage of the total
Agriculture (net area sown)	2 061.37	43.5
Forest	2 360.48	49.8
Non-agricultural uses	243.68	5.1
Barren and uncultivable	28.02	0.6
Others	49.31	1.0
Total	4 742.86	100.0

Source: Govt. of Kerala (1980a)

It can be seen that about 50 percent of the geographical area is classified as forests. The actual forest area is significantly less than this. Nevertheless, the district is more densely forested than others in the State. Of the agricultural crops coconut and rice are the most important, accounting for about 67 percent of the net cropped area. Tapioca (cassava), rubber, arecanut, pepper, cardamom, cashew, banana and pulses are the other crops grown in the district.

Forest cleared for oil palm cultivation

2.4 Industrial Development

Inter-regional comparison based on indicators such as number of industrial establishments under factory sector, fixed capital utilised, total worth of output produced, value added by manufacture and total number of persons employed in manufacturing, Quilon District has been ranked second in the State. However, the situation cannot be considered as satisfactory. By the end of 1981 there were 901 registered working factories in the State providing full-time employment to about 124 600 workers. Cashew processing is the most important industry and accounts for about 87 percent of the employment in the district. A major portion of the raw nuts is imported from East Africa. Cashew kernel is an important export item of the State. Automobile workshops, general engineering and cotton textiles are other important industries in terms of employment and value-added generation. There is also about 2 300 registered small-scale industrial units and 186 industrial cooperative societies. Travancore Plywood Industries and Punalur Paper Mills are the major wood-based industries. In addition, there are a large number of small-scale units involved in the production of plywood, packing cases, matches, handicrafts, bamboo and reed baskets, etc.

2.5 Forests and Forestry

2.5.1 Forest area

In Table 2.2 the area under forests is shown as 2 360 km^2. Due to differences in the criterion adopted for defining forests, figures furnished by different agencies are difficult to reconcile. A small portion of the forests in the district comes under Trivandrum forest division. Excluding this and the area utilised for non-forestry purposes such as agriculture, irrigation and hydro-electric projects, and cash crop plantations, Chandrasekharan (1973) has estimated the area under forests in the district as 1 784 km^2. Although this estimate is more than a decade old and has only limited value in the context of changes that took place since, in the absence of more reliable information, it is generally used for all forestry planning. Distribution of forests among the four forest divisions in Quilon District is given in Table 2.3 (See Fig. 2.2).

Table 2.3

Forest Area in Quilon District

(Area in km^2)

Forest Division	Area
Ranni	781
Thenmala	476
Konni	303
Punalur	224
Total	1 784

Source: Chandrasekharan (1973)

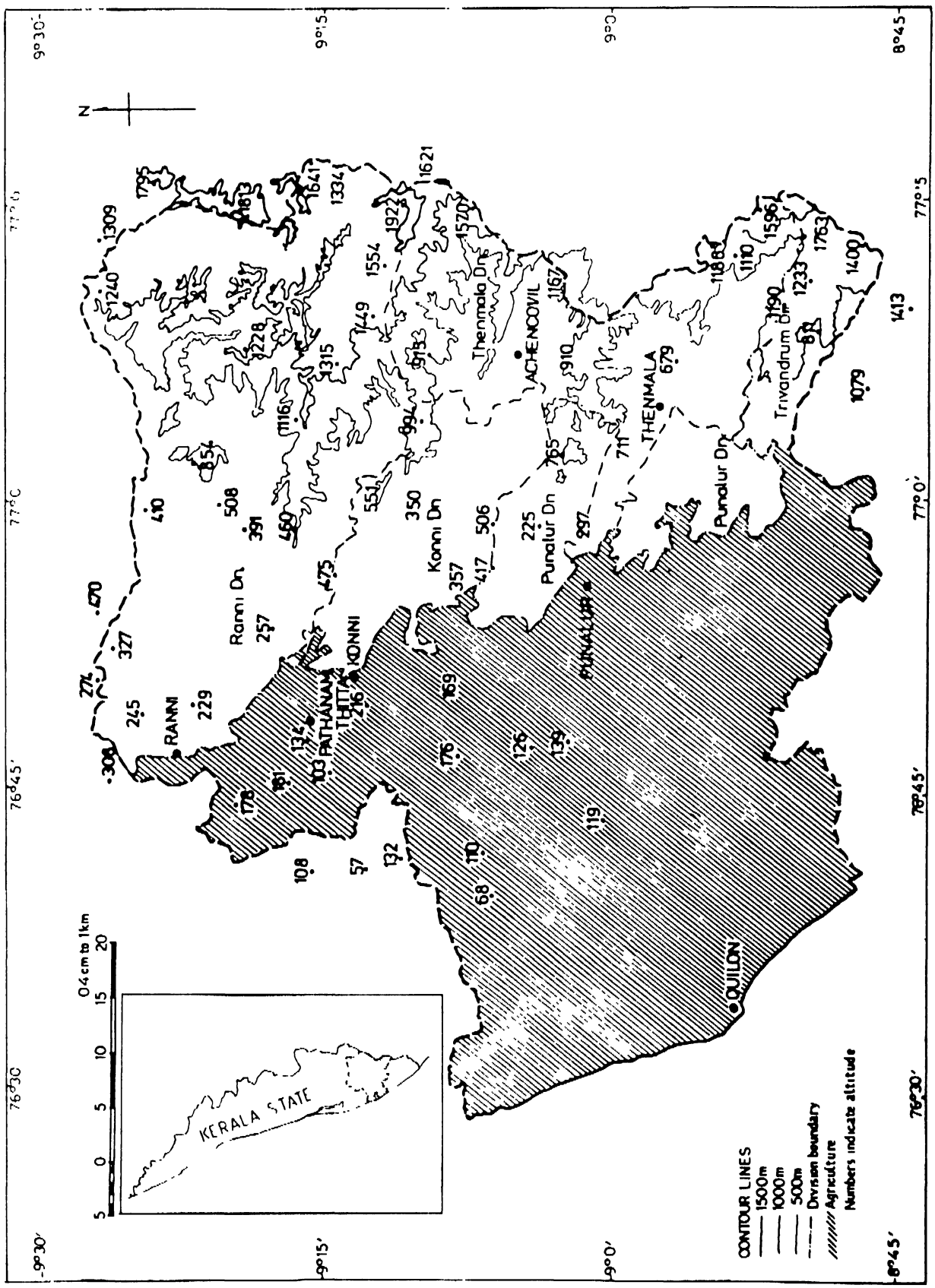


Fig. 2.2 Quilon District showing forest and agriculture

A major portion of the forests in Konni and Punalur divisions are located close to thickly populated areas. In contrast, forests in Thenmala and Ranni divisions, especially Goodrical, Kallar, Achencovil and Shendurney are away from habitations and are comparatively less accessible. Accessibility to forests and population pressure in adjoining villages are important factors that influence forest land use.

2.5.2 Forest Types

Distribution of area under different forest types is given in Table 2.4.

Table 2.4

Forest Types in the Study Area

Type	Area (in km^2)	Percentage of the total
1. Evergreen forests	526	29.5
2. Semi-evergreen forests	502	28.1
3. Moist deciduous forests	395	22.2
4. Reeds	60	3.3
5. Grassland	3	0.2
6. Forest plantations	298	16.7
Total	1 784	100.0

Source: 1. Chandrasekharan (1973)
2. Karunakaran (1982)

Location of natural forests and plantations in the study area is indicated in Fig. 2.3.

Important characteristics of these different types, especially evergreen forests, moist deciduous forests and teak plantations, on which the study is focused, are given below.

2.5.2.1 Evergreen Forests

Evergreen forests are found primarily in the Kakki, Pamba, Moozhiyar, Kallar, Shendurney and Rockwood valleys (Fig. 2.3). In all these localities the annual rainfall exceeds 3 000 mm. The warm wet climate permits more or less unhindered growth throughout the year. The relative humidity seldom falls below 80 and during the rainy season, it reaches more or less saturation point. The rock and soil vary considerably. Gneiss and granite are the main rock formations in the study area. Under the forest cover soil is extremely rich in organic matter. Except in valleys, soil is generally very shallow.

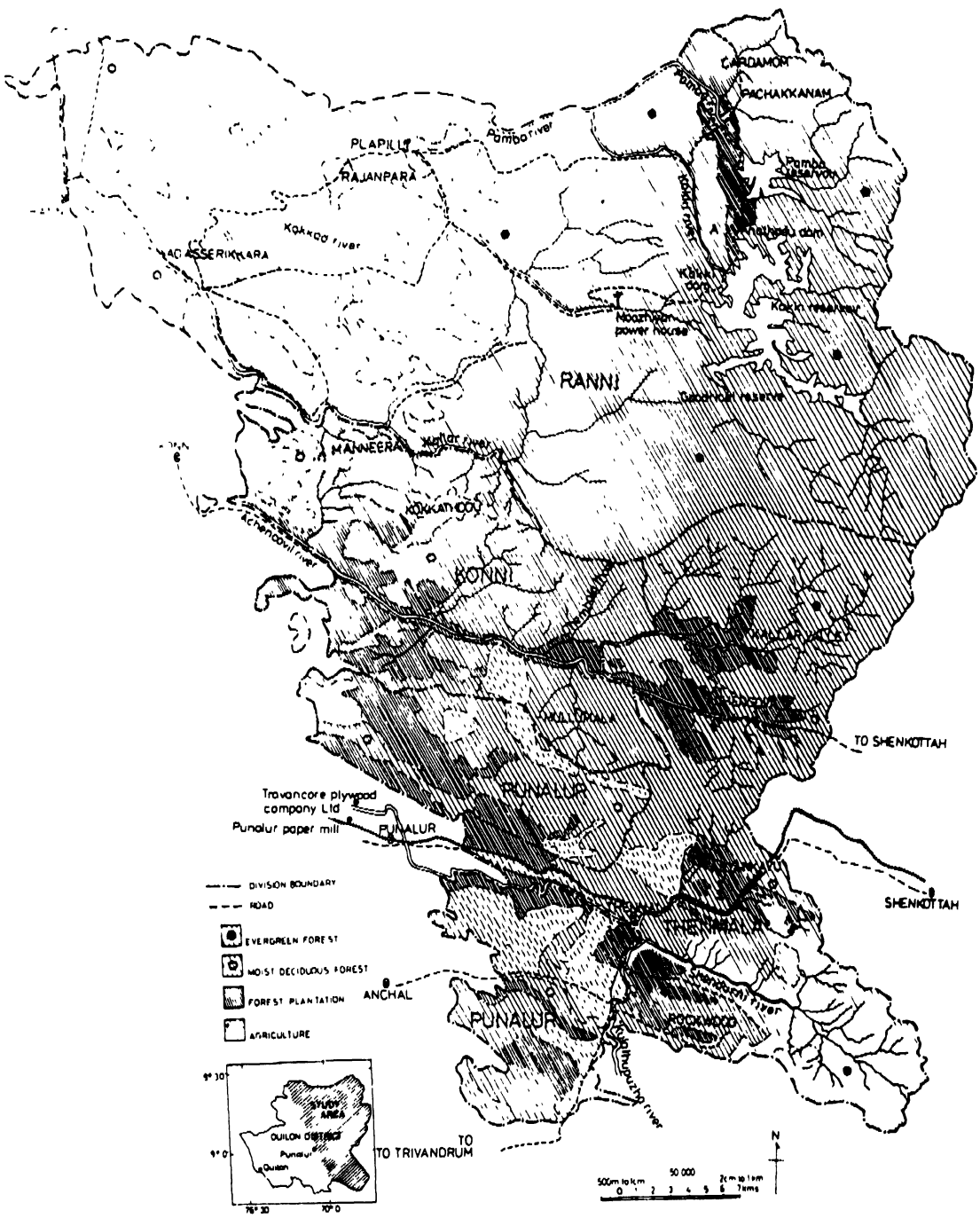


Fig. 2.3a

Land use in the study area showing forests, agriculture and plantations

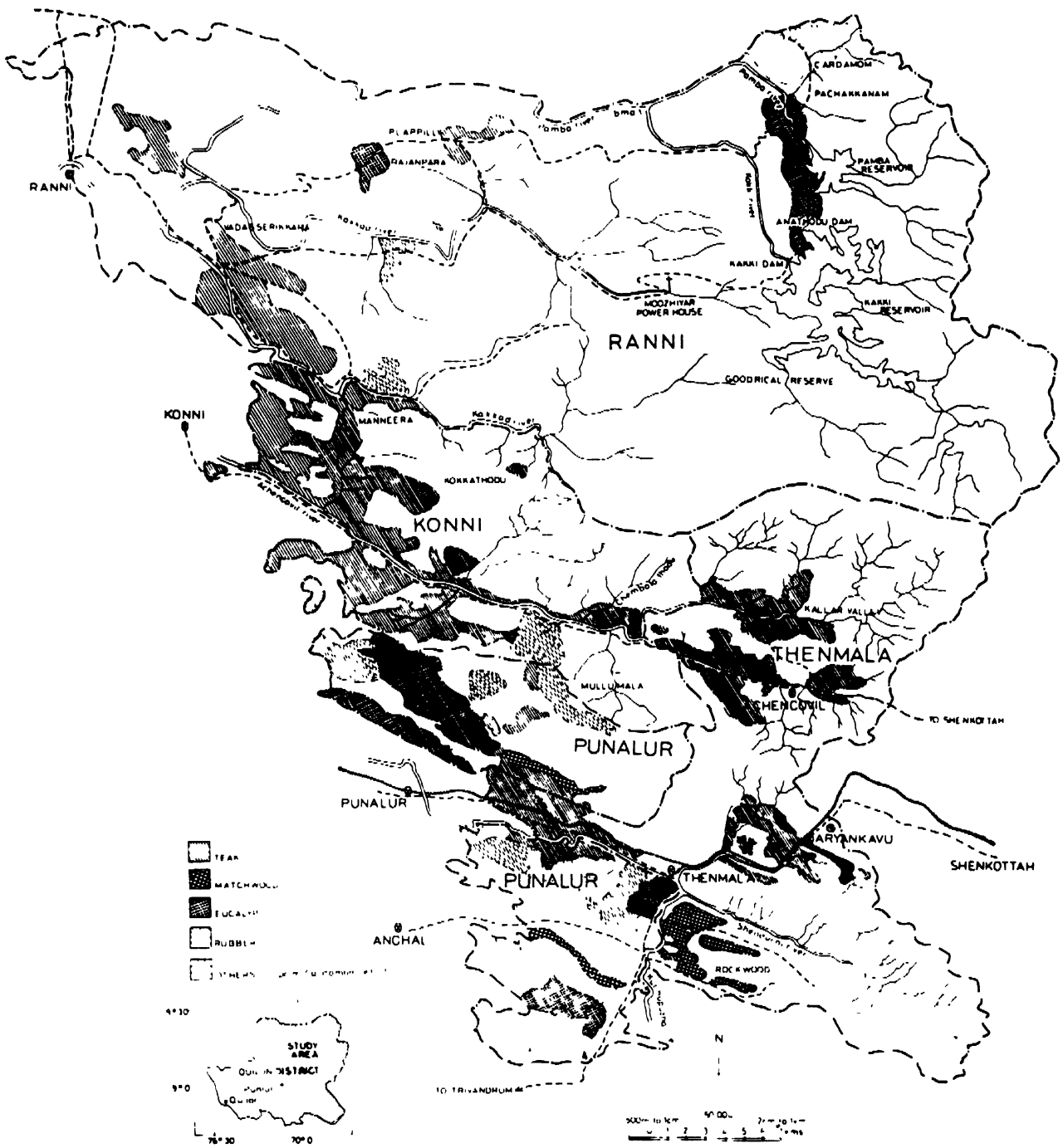


Fig. 2.3b

Plantations in the study area

In the Western Ghats region tropical wet evergreen forest has two climatic climax types, namely: (1) West Coast Tropical Evergreen Forest (type 1AC4) and (2) Southern Hill Top Tropical Evergreen Forest (1AC3), (Champion and Seth, 1968). The evergreen forests are characterized by a bewildering multiplicity of species, usually arranged in layers. Dominants in the top canopy reach a height of over 45 m. Gregarious dominants are seldom met with. Typically most of the dominant trees have cylindrical bole and smooth bark and there is considerable similarities in leaf shape, colour, bark texture, etc. Plank buttresses are common, and is an adaptation for support in shallow soils. Epiphytes such as orchids, ferns and mosses are numerous. Cauliflory is common among a number of species. In an undisturbed forest light seldom reaches the ground and bushy undergrowth and grasses are absent.

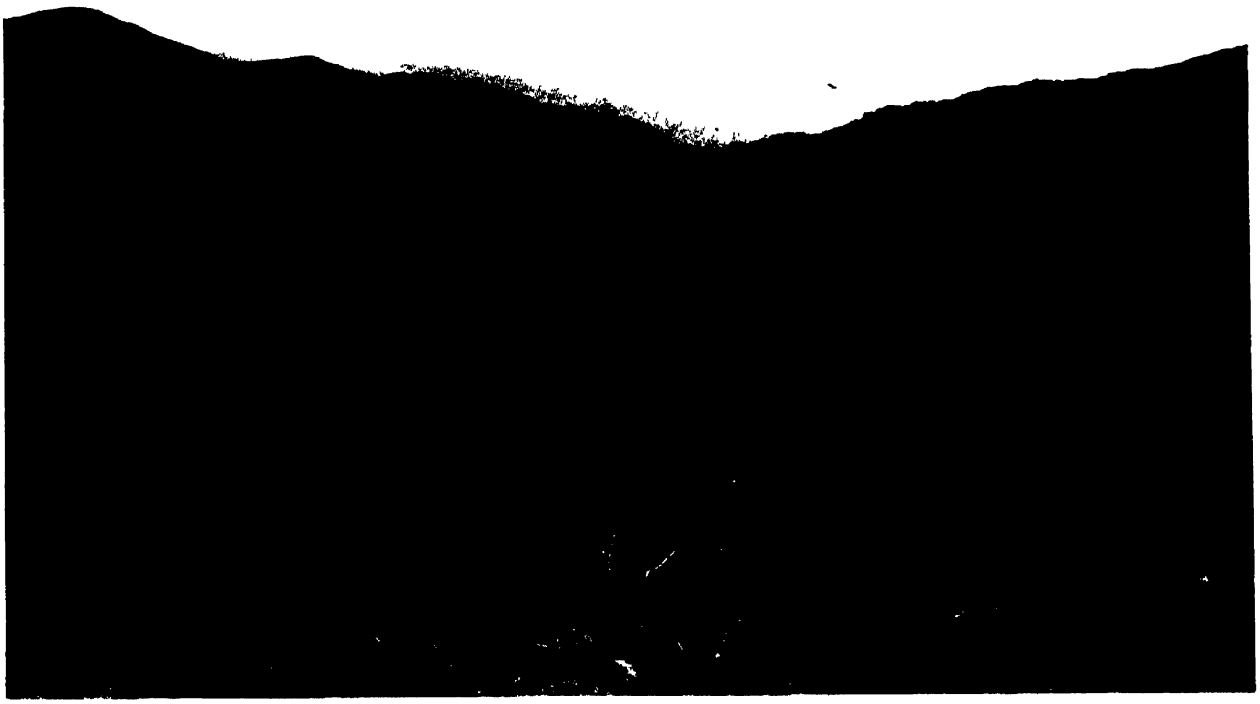
Two sub-types of west coast evergreen forests are recognised, namely: (1) low level evergreen forests occurring up to an elevation of about 500 m and (2) high level evergreen forests occurring above 500 m. Low level evergreen forests are found in Shendurney, Kallar and Pamba valleys in the study area. Members of Dipterocarpaceae such as Dipterocarpus indicus, D. bourdillonii and Vateria indica are the characteristic species. High level evergreen forests occur in the Kakki catchment in the study area. Dominant species found here are Cullenia exarillata, Dichopsis ellipticum, Canarium strictum, Mesua nagassarium, etc.

Distribution of trees in the different species in one of the representative evergreen forest in the study area is given in Table 2.5.

Reed brakes (Ochlandra spp.) naturally occur along stream banks and moist localities. Where canopy is open due to fire or logging it comes up as a pioneer, often in pure patches.

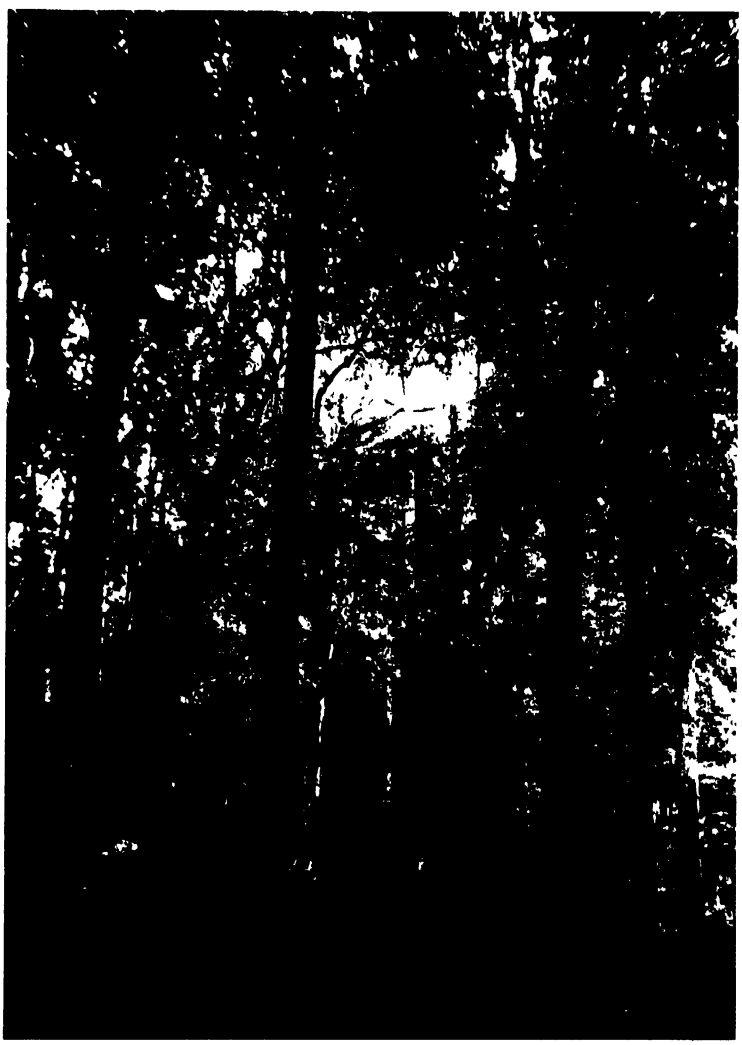
The Southern Hill Top Tropical Evergreen Forest (type 1AC3) is found in the upper slopes of hills in Ranni and Thenmala divisions between 1 000 to 1 250 m and merges with the high level type of the west coast evergreen forest. Champion and Seth (1968) consider this as an inferior type. The important species found in this forest are Mesua nagassarium, Dysoxylum malabaricum, Dichopsis elliptica, Eugenia spp., etc. Generally these forests occur in protected valleys.

Semi-evergreen forests are found in the transition zone between moist deciduous and wet evergreen forests. It is seen in all divisions in the study area. Champion and Seth (1968) consider this as a climatic climax as it occurs primarily on tracts where the moisture conditions are adequate for its development, but at the same time inadequate for an evergreen climax. Some authors, however, regard semi-evergreen forests as a seral stage tending to progress towards the evergreen stage if left undisturbed totally. This type is characterized by an admixture of evergreen and deciduous species, and the predominance of the former gives the evergreen appearance. Important species found in this forest are Terminalia paniculata, Lagerstroemia microcarpa, Persea macrantha, Tetrameles nudiflora, Alstonia scholaris, etc. For management purposes semi-evergreen forests are usually clubbed together with the evergreen forests and get allotted to the protection or selection working circles. However, there are instances where they have been clear-felled along with the adjoining moist deciduous forests for raising plantations.



High level evergreen forest in Ranni Division, interspersed by grassy blanks

A semi-evergreen forest with a sprinkling of deciduous trees



Inside the tropical wet evergreen forest

Table 2.5

Distribution of Trees Under Different Species[1/]

Species	Percentage to the total number
Dichopsis elliptica	6.3
Cullenia exarillata	5.4
Mesua nagassarium	4.8
Vateria indica	4.3
Holigarna arnottiana	4.2
Dysoxylum malabaricum	3.4
Syzygium cumini	3.3
Diospyros candolleana	3.1
Dipterocarpus bourdilloni	2.1
Myristica attenuata	2.0
Anacolosa densiflora	1.8
Gluta travancorica	1.7
Persea macrantha	1.6
Polyalthia fragrans	1.6
Sterculia foetida	1.5
Hopea parviflora	1.4
Bocagea dalzelli	1.2
Elaeocarpus serratus	1.2
Canarium strictum	1.1
Mangifera indica	0.9
Vitex altissima	0.8
Bombax ceiba	0.8
Artocarpus integrifolia	0.6
Schleichera trijuga	0.5
Artocarpus hirsutus	0.4
Alstonia scholaris	0.3
Stereospermum suaveolens	0.3
Ailanthus triphysa	0.2
Others[2/]	43.2
Total	100.0

1/ Sample enumeration at the time of preparation of working plan is limited to trees of 30 cm gbh and above

2/ All species which are not marketable and whose identity cannot be established by enumerators are included under this category

Source: Achuthan (1982)

2.5.2.2 Moist Deciduous Forests

Moist deciduous forests occur in the Aryankavu, Achencovil and portions of Kallar valley, Rajampara and Ranni reserves. This type is generally found in areas with a rainfall between 1 500 mm and 2 000 mm. Champion and Seth (1968) treat this as a climax type. But where biotic interferences are severe, it could also occur as a sub-climax. The dominant species are mostly deciduous, but occasionally evergreen dominants are also met with. Association of dominant species is common in moist deciduous forests, and this primarily depends on the edaphic conditions. Important species found in moist deciduous forests are Terminalia tomentosa, Xylia xylocarpa, Tectona grandis, Buchanania lanzan, Haldina cordifolia, Dalbergia latifolia, Bombax ceiba and Lagerstroemia microcarpa. Distribution of the number of individuals under each species in a representative moist deciduous forest in the study area is given in Table 2.6.

Table 2.6

Species	Percentage of trees in the species to the total number (30 cm and above)
Xylia xylocarpa	21.8
Terminalia paniculata	14.4
Lagerstroemia microcarpa	8.7
Calophyllum tomentosum 2/	4.4
Grewia tiliifolia	2.3
Persea marantha 2/	5.1
Tectona grandis	3.9
Terminalia tomentosa	2.2
Knema attenuata 2/	3.3
Dysoxylum malabaricum 2/	1.4
Artocarpus hirsutus	1.4
Dalbergia latifolia	1.2
Bombax ceiba	1.0
Schleichera trifuga	0.8
Haldinia cordifolia	0.7
Tetrameles nudiflora	0.7
Pterocarpus marsupium	0.5
Others	26.2
Total	100.0

1/ Compiled from the enumeration figures of the Rajampara reserve in Ranni forest division

2/ These species, although not typically found in moist deciduous forests, have got included here due to their presence in semi-evergreen patches in the reserve

Source: Pillai (1974)

Bambusa arundinacea is an important bamboo that occurs in moist deciduous forests. In the drier parts sporadic occurrence of Dendrocalamus strictus is also reported (Ashary, 1967). Regeneration of important species is generally poor. Occurrence of annual fires is an important reason for the deficiency of regeneration. There is a preponderance of mature and overmature trees but saplings and poles are not present adequately. Although floristically moist deciduous forests are less diverse than evergreen forests, there is a large number of commercially valuable timber species. Since a major part of the accessible forests has been either converted into plantations or diverted for non-forestry purposes, moist deciduous forests are now mostly confined to steep slopes and inaccessible ridges. In most areas a process of degradation has set in due to annual fires and other biotic interferences. When forests occur near habitations, illicit collection of timber and firewood is rampant. The general strategy adopted in the management of these forests is to extract the valuable timber and to convert suitable areas into plantations. Details of this are discussed in chapter 6.

2.5.2.3 Forest Plantations

The distribution of man-made forests under different species is given in Table 2.7.

Table 2.7

Area Under Man-made Forests[1/]

Species	Area (ha)	Percentage of the total
Teak	16 580	55.6
Eucalyptus[2/]	6 384	21.4
Matchwood[3/]	5 938	19.9
Others[4/]	937	3.1
Total	29 839	100.0

1/ As on 31.3.1982

2/ Includes plantations raised by the Kerala Forest Development Corporation and the Grassland Afforestation Division

3/ Includes the matchwood plantations raised by the Kerala Forest Development Corporation

4/ This category includes a large number of species such as Albizia falcataria, Gmelina arboria, Artocarpus hirsutus, Hopea parviflora and Swietenia macrophylla raised on an experimental scale

Teak has been the principal plantation species and this situation continued up to the 1960s. Familiarity with the species and assured success under most situations have been responsible for this preference. The fertile alluvial banks of Achencovil river provided ideal conditions for the growth of teak. In addition to the regular planting programme undertaken in different divisions, a special division, Kallar Valley Teak Plantation Division, was created in 1964 to plant about 3 000 hectares with teak. By 1982 about 1 600 hectares have been planted. Due to exhaustion of suitable areas fit for conversion, the rate of annual planting has gone down during the last two years. With the extension of teak into less suitable localities, the proportion of area under lower quality classes has increased. Konni Division has the largest area under teak and has the earliest plantations raised in the study area. Distribution of teak under different quality classes in this division is given in Table 2.8.

Table 2.8

Distribution of Teak Plantations
Under Different Quality Classes

Quality Class	Percentages to the total
I	6.9
II	29.0
III	47.7
IV	16.4
Total	100.0

Source: Compiled from Working Plans

Site quality is assessed with reference to the All India Yield Tables (Forest Research Institute & Colleges, 1970) using top height as the parameter. Table 2.9 gives the important stand parameters for the reference age of 50 as given in the yield tables.

Table 2.9

Stand Parameters for Teak Under Different Site Qualities
(reference age 50)

Site quality	Top height (m)	Crop height (m)	Crop diameter (cm)	No. of trees per ha	Stemwood and small timber	
					MAI*	CAI*
I	30.48 to 36.58	33.53	55.4	94	10.00	6.72
II	24.38 to 30.48	27.12	39.9	136	7.07	5.32
III	18.38 to 24.38	20.73	26.4	230	4.41	3.15
IV	12.19 to 18.29	14.32	17.1	400	2.17	1.47

* Mean Annual Increment (MAI) and Current Annual Increment (CAI)

Source: Forest Research Institute & Colleges(1970)

Yield is a function of both site quality and stocking. The latter varies considerably between plantations in the study area. Stocking is very poor in a number of plantations, and this particularly affects the thinning yield, and could possibly affect the quality of logs obtained during final felling. Details of the management of teak plantations will be discussed in chapter 6.

Eucalyptus was first introduced to the study area in 1960 in the high range grasslands of Goodrical reserve of Ranni Division under the grassland afforestation scheme. Two species of eucalyptus are raised, namely E. grandis and E. tereticornis. The former is raised at higher elevations above 500 m, while the latter is used for planting low elevation areas. Eucalyptus (E. tereticornis) was introduced to Thenmala and Punalur Divisions in 1965, and is used primarily for reforestation of cleared areas. With the establishment of Kerala Forest Development Corporation in 1975, whose primary objective is to enhance wood supply to the pulp and paper industry, eucalyptus plantations began to be raised extensively. One of the plantation units of the Corporation is located in the study area, at Punalur, and it envisages the conversion of 13 000 hectares of moist deciduous forests into eucalyptus plantations.

Eucalyptus plantations are managed on a coppice rotation of 8 years. Performance of the plantations varies considerably. There are exceptionally good plantations where the mean annual increment has exceeded 35 m^3/ha. There are also plantations with a mean annual increment of less than 5 m^3/ha. The average yield is far less than the anticipated yield. Fire, diseases and faulty management - incorrect choice of site, lack of supervision, etc. - are some of the underlying reasons for the low productivity of eucalyptus plantations.

The first attempt to raise matchwood plantations was made in Thenmala Division in 1952. This was primarily aimed at enhancing wood supply to the match industry. Semul (Bombax ceiba) was the favoured species. The first plantation was a failure. Nevertheless, further attempts continued, and in 1954 ten hectares were planted. Gradually, the annual planting programme increased considerably. During the Second Five-Year Plan (1956-61) specific allotment and a subsidy were made by the Central Government to encourage planting of matchwood species. Interestingly the term matchwood is a misnomer, and in most instances teak accounts for a major proportion of plants in these plantations. This aspect will be discussed in chapter 6.

2.6 Demand on Forests

For convenience, the demands on forests can be categorised into three, namely, local, regional and national depending upon the place of origin of demand. Demands can be further grouped into two, namely: (1) for land, and (2) for products. The pressure exerted on forests in the study area due to these different demands are briefly discussed below.

2.6.1 Local Demand

Forests have to satisfy both industrial and non-industrial demand and both exist in the study area.

2.6.1.1 Industrial Demand

Two important wood-based industrial units in the study area are (1) The Travancore Plywood Industries, a Kerala Government Company, and (2) The Punalur Paper Mills, a private sector undertaking.

The Travancore Plywood Industries was established as a public limited company and was moved to Punalur in 1943 to facilitate easy procurement of veneer logs. Installed capacity of this unit is 2.28 million m^2 (4 mm thickness) and it employs about 500 workers. Earlier Shendurney valley in Thenmala Division was the main source of wood supply to the unit and only Vateria indica was being used. Supply from adjoining forests has been found insufficient for two reasons namely: (1) increase in the installed capacity and (2) depletion of timber stock. This has led to: (1) acceptance of a number of species previously unutilised, and (2) extension of the wood catchment area. Currently Travancore Plywoods is using Mangifera indica, Dipterocarpus bourdillonii, Persea macrantha, Dichopsis elliptica and Canarium strictum, although they still prefer Vateria. Initially the mill could meet all its veneer log requirements from adjoining forests but now the catchment area has extended as far as Goodrical range in Ranni Division, about 150 km from the factory site. There are also instances when the unit imported veneer logs from Andaman and Nicobar Islands. The important products of the units are: (1) waterproof plywood, (2) teak-faced decorative plywood, (3) shuttering plywood, (4) chequered plywood for vehicles, (5) marine grade plywood, (6) packing cases for tea and tobacco, and (7) chair seats and backs. Most of the products are marketed within the country.

The Punalur Paper Mills established in 1890 is one of the oldest paper mills in Asia and is the only bamboo-reed-based paper mill in the world. The installed capacity of the unit is 50 000 tons per annum and it employs about 1 075 persons. To begin with, reed was only forest-based raw material being used by the mill. Being a large-scale user of reeds in Southern Kerala, it was able to procure raw material on favourable terms for a very long period. Addition to the installed capacity, diversion of reed-bearing areas for other uses and growth of other reed-using industries have enhanced the gap between demand and supply. Partly due to this, only 35 percent of the installed capacity could be utilised during the last three years. Non-availability of reeds has led to increasing substitution with eucalyptus wood. It has also become necessary to tap distant sources outside the study area. Currently the mill obtains reeds from Kulathupuzha, Chalikkal and Moozhiyar in the study area and from forests in Edamalayar, Periyar Tiger Reserve and Adimali outside the study area.

The Punalur Paper Mills produces special quality paper and 70 percent of the production goes for industrial uses. The remaining 30 percent consists of printing and writing paper. There is a statutory requirement to supply 3 500 tons of writing and printing paper to the government of Kerala.

In addition to the above two major wood-based units, there are a large number of small-scale units in the study area. There are 80 registered saw mills in the district and some of them, especially those in urban areas depend on timber obtained from forests. About 450 workers are employed in the saw-milling industry in the district. There are 23 match units which employ about 270 workers. Wood supply from the forests is far short of their requirements. Often matchwood units get only 10 percent of their demand from forests. The balance is made up from timber obtained from house compounds.

2.6.1.2 Non-industrial Demand

Except the forests in interior localities in Ranni and Thenmala forest divisions, all others are surrounded by densely populated villages and pock-marked with food production areas, settlements, etc. Firewood, small timber and green manure are some of the important products demanded by rural communities. Currently there is no system for making available these products and partly due to this, villagers indulge in unauthorised collection. No estimate is available on the quantity so removed. However, the number of forest offences detected, given in table 2.10 provides an indication of the magnitude of the problem.

Table 2.10

Illicit Removal of Forest Produce

Year	No. of reported offences
1976-77	731
1977-78	950
1978-79	1 073

Source: Administration Reports of the Forest Divisions

It must however, be borne in mind that reported offences from only the tip of the iceberg. More often, acute seasonal unemployment is an important factor that leads to illicit removal of forest products. Even teak plantations are prone to poaching and this supports a flourishing trade of furniture and other items.

2.6.2 Regional Demand

Being more forested than most other districts, a large quantity of wood and other products moves to distant consumption centres both within and outside the State. Plywood manufacturing units situated even in the Northern most district in the State, Cannanore, meet part of their veneer log requirements from these forests. Eucalyptus wood from the study area is supplied to the Rayon Pulp Unit at Calicut and the Newsprint Unit near Kottayam. A large quantity of general construction timber is transported to the adjoining state of Tamil Nadu. In fact, timber market in the study area is controlled to a great extent by Tamil Nadu traders.

2.6.3 National Demand

Railway sleepers and good quality teak wood required by defense and railways are supplied from forests in the study area. Large-scale selection felling was undertaken in the Kakki forests in Ranni Division to supply railway sleepers. A major portion of the sleeper requirements for the proposed Ernakulam-Alleppey railway line in Kerala may also have to be met from these forests.

2.6.4 Demand for Land

Demand for land is a derived demand and in the study area it arises from local people, public and private sector enterprises and government departments. Forest area given to various public sector agencies for non-forestry purposes is given in Table 2.11.

Apart from government-sponsored schemes for assigning arable land, settlement of tribals, etc., extensive forest areas have been utilised for agriculture through encroachment. No estimate is available of the area encroached in the different divisions.

Table 2.11

Forest Area Utilised for Non-forestry Purposes

(Area in ha)

Agency	Purpose	Area diverted
1. Electricity Board	Submergible area of Sabarigiri project and strips of land under high tension lines	Not known
2. Irrigation Department	Submergible area of Kallada Project	1 373
3. State Farming Corporation	Cultivation of rubber and sugarcane	2 528
4. Oil Palm India Ltd.	Cultivation of oil palm	3 400
5. Rehabilitation Plantations Ltd.	Rubber cultivation to resettle Sri-Lankan repatriates of Indian origin	2 265
6. Plantation Corporation of Kerala Ltd.	Rubber Plantation	1 736
7. Revenue Department Arable Land Scheme	Assignment of land to evacuees from project sites, Scheduled Castes, Ex-Servicemen, etc. for agriculture	3 631

2.7 Summary and Conclusions

From the discussion it is clear that the study area, like the rest of the State, has two major problems, namely: (1) high population density, and (2) high unemployment and under-employment. Agriculture is the major source of livelihood. However, the average size of land holding is very low. Most of the industries are either agro-based or forest-based and industries with low direct and indirect land requirements have not yet developed.

Evergreen forests and moist deciduous forests form the most important natural vegetation in the study area. Both are characterized by a multitude of species of which only a few are commercially valuable. Management of the more easily accessible moist deciduous forests aims at converting them into man-made forests. Presently man-made forests account for about 17 percent of the total forest area.

Forests in the study area have to cater to several types of demand for products and for land. In addition to meeting the raw material requirements of the plywood unit and the pulp and paper unit located in the study area, wood has to be supplied to a large number of units both within and outside the study area. Demand for land, both from agriculturists and government owned corporations also exists and the process of diversion for non-forestry purposes continues unabated.

CHAPTER 3

HISTORY OF FOREST MANAGEMENT

To understand the factors that have contributed to a particular land use pattern, it is imperative to examine the features of the economy and the changes that take place over time. Forestry has a long history in the study area. An understanding of how the various social, political and economic factors have acted upon forest land use will be useful for broadly indicating what could happen in future. In this chapter an attempt is made to trace the history of forest management in the study area.

A historical analysis is conveniently done by describing the changes during specified periods. Change being a continuum, its compartmentalisation into periods tends to be arbitrary. However, such an approach is advantageous and sometimes inevitable. For the present study, based on the political situation, two broad periods are identified, namely: (1) pre-1947 era, and (2) post-1947 period. During the former, Travancore was a princely state while a major portion of the rest of India was under the British rule. The post 1947 period is characterized by the amalgamation of the princely states into the Indian Union and the transfer of power to democratically elected governments.

3.1 Pre-1947 Era

Travancore emerged as a political entity around the middle of the 18th century when Venad, a petty kingdom, conquered its neighbouring principalities with the help of the English East India Company. Trade was the main source of income of the State, and to monopolize trade in several important items a commercial department was formed. The East India Company helped the territorial expansion and consolidation of Travancore, which in turn enabled the company to wield considerable power and influence. The Company's representative to the Court of Travancore, commonly addressed as the Resident, in fact, became the Diwan (Prime-Minister) in 1811. This had a tremendous impact on the policies of the Travancore Government.

Prior to the emergence of Travancore, the system of state taxes on land did not exist in Kerala. The agricultural lands were then owned by powerful feudal lords and temples. The consolidation of Travancore displaced many feudal lords and the State became the largest land lord. Consequently land revenue became significant in the budget. The enhanced tribute demanded by the East India Company could only be paid by increasing government revenue. To augment the revenue the Resident-cum-Diwan took two important steps, namely: (1) the properties of 378 wealthy temples which were exempt from state taxes were nationalised thus securing land revenue from the tenants occupying those lands, and (2) encouraging extension of the area under cultivation.

3.1.1 Forest as Waste Lands

More than two-thirds of the country were under forests or remained uncultivated at the beginning of the 19th century. Forests were considered as waste lands at that time. Around 1818 government initiated a programme to extend cultivation into the waste lands. Cultivators were encouraged to open up forest lands through tax exemption for a prescribed number of years, subsidised supply of provisions to hill cultivators, crop protection from thieves and wild animals, abolition of export duty on cereals, etc. Cardamom cultivators received preferential treatment due to its importance to the state revenue. A Cardamom Department was formed in 1823.

The transfer of power from the East India Company to the British Crown in 1858 influenced the subsequent land use in the Western Ghats region. British planters, with the support of the Resident, began clearing forests to raise plantations of coffee, tea, cardamom, etc. The pressure from the European planters and the local agriculturists resulted in a liberalised government policy towards cultivation in forests. In 1865, rules for the sale of waste lands for coffee and other cultivation were laid down and full ownership rights similar to the British system were granted to the tenants of government lands.

Consequent to the laissez-faire policy towards forest land, forest clearing proceeded without check, especially since 1865. Many early clearings were abandoned after a short period. The government tried to control the clearings and protect valuable timber by issuing rules in 1869 and 1881. But they were generally ineffective on account of ambiguities in the provisions and absence of penal conditions.

3.1.2 Timber as a Source of Revenue

The kingdoms on the Kerala coast were engaged in the trade of spices from very early times. The Arabs, who had monopoly over sea trade before the European era, imported teak timber for ship building. Superiority of teak for this purpose enhanced its importance in export trade. The earliest information on timber extraction from forests in Travancore is given in the Memoirs of Lts. Ward and Conner who surveyed the country during 1816 to 1820. According to them, forest areas bordering rivers were leased out to contractors for extraction of teak. They also mention that by the time of their survey most of the marketable teak had already been removed from accessible areas.

In 1816, the Resident-cum-Diwan who was on the look out for ways to improve the State finances brought in an English officer to head the Commercial Department. The Chief of the Commercial Department - Commercial Agent - was also designated as the Conservator of Forests. The duty of the Commercial Agent-cum-Conservator was to oversee, operate and trade with the articles of State monopoly. In 1816, government started to extract teak directly. Timber other than teak could be freely removed by people.

During the early 1820s the Conservator's office was made independent of the Commercial Agent. The Conservator's task was to work down teak from the Periyar and Achencovil rivers and deliver them to the Commercial Agent at Alleppey along with the cardamom collected. Between 1820 and 1865 the list of government monopoly swelled to include rosewood (Dalbergia latifolia), anjili (Artocarpus hirsutus), ebony (Diospyros ebenum) and sandal wood (Santalum album). An assistant to the Conservator was posted at Ranni to supervise logging. Initially the quantity collected was not much and therefore the department could organise timber extraction. With the increasing demand, departmental logging was found to be inadequate. Contracts for logging and transporting timber to the depots were therefore given to private parties from 1879. By 1882 the departmental workinging of timber was completely substituted by the contract system.

Tapping timber wealth became an important source of revenue and the net surplus of the forest department increased from Rs. 89 050 in 1872 to Rs. 311 306 in 1892.

3.1.3 Permanent Reservation of Forest Tracts

The idea of declaring a tract of forest as reserved was an extension of the principle of reservation of trees and was done to facilitate the exercise of ownership right over the ever-increasing number of marketable trees. Land reservation originated in British India and was soon adopted in Travancore also. The government policy regarding forests was first articulated by Lord Dalhousie in 1855. The Indian Forest Act 1865

contained provisions for constituting permanent forest reserves. Another act passed in 1878 distinguished two classes of forests, viz., reserved forests and protected forests. In the neighbouring Madras Presidency, a forest act was enacted in 1882. For the creation of a reserve, a notification was issued by the government and private rights admissible were recorded at the time of settlement.

In Travancore a Commission was appointed in 1884 to examine different aspects of forest management. The Commission recommended the enactment of a forest law and prepared a draft more or less copying all the provisions from the Madras Forest Act of 1882. A modified version of the draft was enacted in 1887 and the first forest reserve in Travancore was constituted in accordance with the Act in the same year. The progress in forest reservation in Travancore is shown in the following table.

Table 3.1

Progress of Constitution of Reserve Forests in Travancore

Year	Area of reserved forests (km^2)
1888	780
1889	2 264
1900	3 412
1910	6 043
1925	6 212
1935	6 227

Source: Bourdillon (1893)
Pillai (1940)

3.1.4 Plantation Forestry

Teak plantations began to be established in the British Indian district of Malabar from 1842 onwards. Plantation forestry developed in Travancore as a sequel to the demonstration effect. European planters had started clearing forests for raising coffee and other cash crops in the 1860s. Following the lead of private planters, Travancore government had raised a nursery of cinchona (Cinchona officinalis) with the objective of opening a plantation. Reports on the uncertain performance of cinchona elsewhere prompted the government to shelve the programme and to go in for teak (Jacob, 1932). The justification was that if good quality teak can be grown, the income therefrom could be utilised to import quinine. The first trial was made in 1865. Although it was a failure, regular teak planting commenced from 1867 in Konni and Malayattur. The appointment of an officer, experienced in raising teak in Nilambur Plantations, made the task easy.

During the first phase of teak planting in Travancore from 1867 to 1892, opening of new plantations was irregular. More systematic planting work was done during the second phase, 1893 to 1907. Proper thinning and regular tending operations were undertaken. A breakthrough was achieved during this phase when stump planting was found successful.

The earlier practice was to plant out 2 to 3 months old nursery seedlings in pits dug before hand. Planting stumps in crowbar holes reduced plantation expenditure considerably. One year old stumps were less sensitive to delay in planting out or lack of rain. This labour-saving technique developed in Travancore was an important factor which helped the opening of large-scale teak plantations.

A variety of experiments with exotic species were also conducted during this phase. Planting trials with Ailanthus grandis, Berrya ammonilla, Cinnamomum camphora, Hevea brasilensis, Swietenia macrophylla, etc. were done on a limited scale. Indigenous species like anjili (Artocarpus hirsutus) and kongu (Hopea parviflora) were also planted as trials.

The third phase starting from 1908 was characterized by: (1) attempts at reducing the unit cost of plantation establishment and (2) increasing the annual planting area. Earlier the site preparation work such as land clearing, burning, etc., was done by the forest department. This system was replaced in 1908 by selling the standing tree growth at the site. The purchaser cleared the site more efficiently and cheaply. The outright sale of standing timber reduced government expenditure and enhanced the revenue substantially.

Weeding and early tending were the other major items of plantation expenditure. The taungya system developed in Burma in the middle of the 19th century was tried in Travancore in 1915. The first attempt was a failure, but subsequently from 1922 onwards, the taungya method became a regular technique of raising teak plantations. In return for permission to cultivate agricultural crops for one and a half years, the peasant or cooperative society agreed to do the clearing, planting and early tending work free of cost in addition to paying a ground rent to the Forest Department. It is to be noted that the sites selected for teak plantations were otherwise excellent for agriculture, being invariably river valleys with rich alluvial soil. The cost of opening one hectare of teak plantation, which was about Rs. 100 to 125 earlier came down to almost nothing under taungya. The pace of planting was accelerated during this phase. Eventhough Travancore started 22 years later than Nilambur, by 1927 the extent of teak plantations in Travancore exceeded that of Nilambur by 675 hectares. The plantations of Travancore were also more impressive than that of Nilambur.

3.1.5 Working Plans as a Tool of Management

As in the case of plantations, the idea of managing forests on the basis of working plans was adopted in Travancore following the trend in British India. This is a sequel to the reorganisation of the Travancore forest department in 1897 on the lines of the British Indian forest administration by Conservator T.F. Bourdillon. The early working plans had the limited objective of regulating timber extraction. Logging was sought to be restricted to pre-determined annual coupes. The first comprehensive plan in the study area was prepared for the forests in Shendurney valley in 1908. Although sound silvicultural guidelines were prescribed, the results were disappointing. Working plans prepared since suffered from the serious defect of taking a long time for preparation. Further, the stringent prescriptions were not being implemented. Over-exploitation of accessible areas could not be effectively controlled because of the insufficiency of field staff and the reliance on contractors who were paid according to the quantity of timber brought to the depot.

3.1.6 Agriculture-Forestry Conflicts

Agriculture expanded to the area occupied by forests principally from two directions. Firstly, there was a rapid expansion of area under plantation crops commencing from the 1860s. European planters were attracted by the abundance of favourably situated land for

A 20 year old Eucalyptus (E. grandis) plantation in the high ranges raised under the Grassland Afforestation Programme. Although, in the case of eucalyptus, the rotation followed is 8 years, a large chunk of the plantations in the high ranges has been reserved for supplying wood to the public sector newsprint unit in Kerala.

Albizia falcataria plantation (1974) in Thenmala Division.

raising plantation crops. Land became a tradeable and mortgageable commodity in 1865, when all government tenants were given permanent rights in the lands cultivated. Encouragement was given for bringing new lands under cultivation. An enterprising class of agriculturists, who has already acquired capital through trade came forward to take up land reclamation work on a large-scale in the plains and European planters began to open plantations of coffee, tea, rubber, etc. on the hills. Supporting services to meet the requirements of the new plantation sector also developed mostly on the security offered by land ownership. Indigenous banking institutions emerged to meet the growing need for finance. Finance for developing agriculture was also forthcoming from the government. The Agricultural Loan Act of 1891 was intended to help needy cultivators.

Improvement of communication facilities was also spectacular. A Department of Public Works on modern lines was organised in 1860. A British engineer was appointed in 1863 as Chief Engineer to head the department. The construction of roads and bridges was expedited by the Public Works Department. This facilitated the rapid colonisation of the hilly region.

Secondly, traditional agriculture expanded from the plains to the adjoining valleys and slopes, primarily as an outcome of population growth. Two types of cultivation were practised in the forests depending on the accessibility and quality of the land. Valleys and swamps were cleared for settled agriculture. Poor and rugged lands were used for shifting cultivation.

The introduction of tapioca (Cassava = Manihot esculenta) into Travancore coincided with the scarcity situation in food supply. Tapioca was immediately accepted as an inferior substitute for rice, the staple food of the plains people. The production of tapioca increased to fill the growing gap between the demand and supply of rice. In the garden lands, tapioca came to be cultivated first as a subsistence crop and shortly after as a cash crop. The bumper yield of tapioca in the forest lands encouraged its cultivation in newly cleared forests. More attractive perennial cash crops like coconut, pepper, coffee, rubber, etc. could be established along with tapioca. The fact that it could be consumed, stored and exchanged for other necessities made it ideal for tiding over the waiting period till the perennial crops reached the yielding stage. The long fallow , which cereal cultivation in the forests required, was no longer necessary. The planting and harvesting work could be spread over a longer period enabling family labour to be used more effectively.

Inadequate food production in the State was offset by imports of rice mainly from Burma during the first half of this century. In 1938 the quantity of rice imported was 5 966 193 Cwt at a cost of Bh. Rs. 24 079 308 making 32 percent of the total value of imports. Rice imports were affected by World War II and an acute shortage of food grains prevailed in Travancore. To overcome this situation the government introduced a scheme for leasing out cultivable areas in the reserved forests starting from 1942. At the first instance 3 230 hectares were leased out for a period of three years. As the food availability did not improve, more and more areas were thrown open for cultivation. No survey and demarkation was conducted and the actual area occupied was much more than official estimates.

The compound annual growth rate of population and cultivated area is shown in Table 3.2.

Table 3.2

Population Growth and Growth of Cultivated Area

Period	Compound annual growth rate	
	Population	Cultivated area
1911 to 1931	2.00	1.34
1931 to 1951	1.97	0.10
1911 to 1951	1.99	0.72

Source: Varghese (1970)

Although the growth of population was steady over the whole period from 1911 to 1951 at 2 percent, the annual increase of cultivated area fell from 1.34 percent during 1911 to 1931 to 0.1 percent during the next two decades. Its implications on food production and availability can well be imagined considering the fact that almost half the cultivated area was producing non-food crops.

The area under rubber, tea and coffee from 1920 to 1950 is given in the following table.

Table 3.3

Area Under Important Cash Crops
(in ha)

Year	Rubber	Tea	Coffee
1920-21	20 640	19 061	-
1930-31	24 444	31 567	-
1940-41	36 706	29 057	2 388
1949-50	45 124	60 057	3 521

Source: Varghese (1970)

It is to be noted that all these crops and others like cardamom were cultivated in lands once covered with forest.

3.1.7 Growth of Wood-based Industries

The pre-1947 period is characterized by poor growth of industries. Since timber was being exported as logs even saw-milling industry was poorly developed. Requirements of the construction sector was mostly met by hand sawing.

A notable development in the study area during this period was the establishment of a plywood manufacturing unit and a paper mill. The establishment of the Travancore Plywood Industry was an outcome of the backward linkage effect of the tea industry. Tea plantations were established primarily to meet the export demand. To facilitate the shipping of tea, plywood for making chests had to be imported from abroad, mainly from Finland, Sweden and Japan. The cost of import rose tremendously during the early decades of this century. Problems encountered in procuring tea chests during the war gave an impetus to the establishment of indigenous manufacturing capability of good quality veneer logs favoured the establishment of the Travancore Plywood Industries at Punalur in 1943. For nearly two decades, the Kannan Devan Hill Produce Company, which owned a number of tea plantations in the high ranges of Kerala was the main customer for chests produced at the Travancore Plywood Industries. The growth of this unit, product diversification, raw material consumption, etc., have already been discussed in chapter 2.

3.2 Post-1947 Period

Travancore became Travancore-Cochin State when it merged with the Indian Union in 1949. Kerala was formed in 1956 by amalgamating Travancore-Cochin State with parts of the Malabar and South Canara districts of the erstwhile Madras and Bombay Presidencies respectively.

Political independence ushered in new trends in the development of forestry. The Forest Policy of independent India was proclaimed in 1952, revising the earlier British Indian Policy of 1894. The objectives of forestry outlined in the Forest Policy are given in chapter 4. Forest was listed as a state (provincial) subject in the Indian Constitution and the state governments could determine the objectives and method of management of forests. The elected governments in the states has two important considerations, namely: (1) meeting the needs of the agricultural sector, and (2) enhancing government income so as to meet the growing expenditure on development works. These had a direct impact on forest and forestry in the state.

3.2.1 Conflicts between Agriculture and Forestry

Diversion of forest land for agricultural purposes which began in the early 1940s continued at a faster rate in the later decades also. The grow more food scheme stipulated afforestation by lessees before resumption of the area by government. Due to continued occupation of leased areas by lessees this could not be carried out. The forest reserves which were once compact blocks were pock-marked by agricultural enclosures and homesteads. The natural growth of population and immigration coupled with the lack of employment opportunities spurred more encroachment on the periphery of the enclosures. Pilferage of forest produce and fire caused by increasing human activity have lowered the quality of the forests. To study the problem of encroachments a popular committee was formed in 1968. The Committee classified the encroached areas into revertable and non-revertable. Non-revertable areas were to be legalised by issuing title deeds to the cultivators and the rest resumed. Survey and settlement work in these lines have been quite slow.

Various government resettlement schemes for ex-servicemen, evacuees from project sites and tribals added to the grow more food, arable land, livestock development and hydro-electric schemes have opened up the reserves. These formed the nuclei for further encroachments. One important reason for the continuing encroachments, apart from the acute pressure on farm lands, is that cultivators expect to obtain permanent rights in the occupied area. The popular governments which came to power after the formation of Kerala have legalised old encroachments several times for political expediency. Checking the growth of agriculture into forests has not been a serious priority of the government. At present all encroachments into reserved forests prior to 1.1.1977 have been legalised.

Agriculture-based public sector units have also been encouraged to take up forest land for cultivation. Currently four public sector units are engaged in agriculture in the study area. They are the Plantation Corporation of Kerala (rubber), Rehabilitation Plantations (rubber), State Farming Corporation (sugarcane, tapioca, cashew and rubber) and Oil Palm India (oil palm). Each of these units were set up for different reasons ranging from resettlement of repatriates from Sri Lanka to reviving a sick sugar mill. These Corporations manage land in various divisions. In the study area, the Punalur Division has the largest area under public sector agriculture. These lands, raising annual and perennial agricultural crops, are still classified as reserved forests due to the technical justification that land has only been leased out and not permanently transferred.

No correct figures exist for the area under cultivation in the reserved forest. The estimates of area occupied by encroacher cultivators in the study area made by the forest department will inevitably be under-estimated for various reasons. Nevertheless it is valuable as an indicator. The Preliminary Working Plan report for Punalur Division estimates that "about 2 000 hectares are under encroachment apart from the areas leased out for food production, Arable Land Scheme, etc. ...". The Administration Report of the Konni Division for the year 1979-80 states "about 1 000 hectares of reserved forest on the margins of Food Production areas of the three ranges are under the threat of encroachment". The Preliminary Working Report for Ranni Division acknowledges the encroachment of 2 000 to 3 000 hectares in the Vadasserikkara Range alone which is proposed to be included in the conversion working circle and planted up with teak. However, attempts hitherto made to reclaim encroached lands by raising departmental plantations have not been successful due to resistance from encroachers.

Most often releasing land for agricultural purposes fulfilled more than one objective. In addition to making available more land for agriculture, the timber released from clear-felling met the demand from industries and traders, it also enhanced government's revenue needed to meet the growing expenditure. Coincidence of such interests has led to large-scale diversion of forests for non-forestry purposes.

Public utility works such as irrigation and hydro-electric projects also have led to considerable reduction in forest area. Very often, the land diversion for the project per se is negligible, but improvement in accessibility enhances the utilisation potential of the land which triggers off large-scale conversion to agriculture as well as plantation forestry.

3.2.2 Plantation Forestry

The major change from the past was the introduction of five-year national development plans. These plans essentially reflected the national priorities. The targets of the five-year plans superseded that of the working plans mainly because investment funds were available as per the provisions of the five-year plans and not as proposed in the working plans.

Priority given to industrial development during the second five-year plan (1956-61) promoted the growth of wood-based industries, particularly the pulp and paper industry. This had a significant impact on forestry. To begin with, the pulp and paper industry was dependent on indigenously available raw material such as bamboo and reed. Their unreliable supply coupled with the enhanced demands due to the growth of the industry led to the raising of extensive plantations of eucalyptus. Encouragement given by the central government through specific allocation for industrial plantations resulted in the conversion of extensive natural forests into man-made forests. In the early 1960s forestry development

was equated with the creation of large-scale plantations. Three special divisions exclusively to raise teak were formed. One of them, the Kallar Valley Teak Plantations, forms part of the study area. A grassland afforestation division and an industrial plantation circle were started during the third plan exclusively to raise eucalyptus. Eucalyptus plantations which accounted for less than 1 percent of the total plantation in the State in 1960, increased to about 25 percent in 1982. Wood from these plantations is utilised exclusively by the pulp and paper industry.

3.2.3 Forestry-industry Linkages

The industrial orientation of forestry which began in the 1960s, got an impetus with the implementation of the recommendations of the National Commission on Agriculture (Govt. of India, 1972; 1976). The Commission emphasised the need for a departure from the traditional conservation oriented forestry towards an aggressive man-made forestry programme linked to the projected requirements of wood-based industries. Two major constraints in undertaking such a programme were identified, namely: (1) insufficiency of investment funds, and (2) institutional impediments arising from the organisational structure of the forest department. To overcome these the Commission recommended the formation of autonomous Forest Development Corporations in all states. A Forest Development Corporation was formed in Kerala also to undertake large-scale pulp wood plantation programme. Although later the Corporation diversified its activities and took up planting of match wood, raising of cardamom, etc., the pulp wood plantation project remains the focal activity.

The trend towards large-scale plantations initiated in 1960s accelerated since the mid-1970s. The forest wealth was viewed in a totally different perspective from that adopted in the National Forest Policy. It was recommended by the National Commission on Agriculture "that future production programmes should concentrate on clear-felling of inaccessible hardwood forests, followed by that of mixed quality forests and valuable forests, and planting with suitable fast growing species yielding higher return per unit area. The resulting produce from the clear-felled areas should be utilised in wood-based industries as far as possible". (Govt. of India, Vol. IX, p. 71). It is also pointed out that "Production of industrial wood is the raison d'ētre for the existence of forests" (Ibid., p. 32).

In 1976, by a constitutional amendment forests were placed in the concurrent list which meant that the central government will have an increasing say in the forest management decisions all over the country. This change from the state list to the concurrent list is significant due to the thinking already widespread among planners and foresters that forests should be rapidly modified to suit the needs of forest-based industries.

3.2.4 Social Forestry

Along with the recommendations for practising production forestry in public forest lands, the National Commission on Agriculture made recommendations for taking up social forestry programmes (Govt. of India, 1973) for increased production of fuelwood, small timber, and fodder and for protection of agricultural fields from erosion. Solving the energy crisis stemming from the shortage of fuelwood remain the main thrust of social forestry and it includes farm forestry, extension forestry, reforestation in degraded lands and recreation forestry (Govt. of India, 1976). In several states new administrative structures have been created to implement social forestry programmes. Some of these programmes are being supported by aid agencies such as the World Bank and the Swedish International Development Agency.

In Kerala, social forestry activities are limited to: (1) raising seedlings and their distribution to individuals (land owners) and institutions, and (2) avenue planting. Since intensive tree cropping is traditionally integrated with the agricultural practices in the State, whether the social forestry programme initiated now will have a significant impact requires a thorough study.

3.2.5 General Trends in Forestry

From the foregoing discussion the general trend in the development of forestry is obvious. Before the constitution of reserves people had more or less complete freedom to utilise the forests in order to satisfy their multivarious needs. When land revenue became an important source of income for governments, cultivators were encouraged to convert waste lands - forests - into farm lands. The forest policy of 1894 adopted in British India stressed that a forest's claim for land can be justified only on the basis of its indirect contribution towards sustaining agriculture. Even in areas where good quality timber could be grown, priority was to be given to meet the needs of the agricultural sector.

With the development of trade and industries the power-base of government shifted from agriculture and this is reflected in the later policy statements and sectoral developmental strategies. By the time the 1952 forest policy was formulated, wood-based industries were established and this influenced the outlook on forestry. The role of forests in providing wood raw material to industries was recognised. Therefore, it was stressed that claims by village communities in the neighbourhood of a forest should not be permitted at the cost of national interests. Since forest was a state subject such policy directives has little impact as the power-base of state governments continued to be the agriculturists. The central government who drew its strength from the industrial sector, however, continued to influence forestry in a subtle manner through the five-year plan programmes by specific allotments and sometimes subsidies to large-scale industrial plantation programmes. With the implementation of the recommendations of the National Commission on Agriculture this trend accelerated. Despite all these, the state governments continued to have the final say in forestry. The transfer of forests from the state list to the concurrent list and the enactment of the Forest (conservation) Act 1980, which curtailed the state government's powers to disreserve forests should be viewed in the context of industrial orientation of forestry. The historical analysis clearly indicates that the trend is away from multiple-use management.

CHAPTER 4

GENERAL DESCRIPTIONS OF FOREST MANAGEMENT

Forest management is defined as the practical application of scientific, technical and economic principles to achieve pre-determined objectives from a forest land. The growing stock and/or land at the disposal of the owner can be put to a number of uses. A forest can be totally left unmanaged and uninterfered with to enhance the watershed and wilderness values. Alternatively, the tree growth can be managed on a sustained yield basis to ensure an even supply of timber. When immediate benefit is the only concern, timber can be mined to maximise profit. Within the timber production alternative, there are several options depending upon the productivity of site, marketability and demand. In the case of tropical forests one should also consider potential future uses of plants and products which are unutilised and under-utilised now.

Like management of other resources, the pre-requisites for proper management of forest resources are:

1. identification of the objectives and priorities;
2. formulation of plans and programmes to fulfil the objectives;
3. establishment of institutions to implement them; and
4. forest legislation defining the relationship between forests and people.

The above aspects of forest management are dealt with in this chapter.

4.1 Objectives and Priorities

The objectives of forest management will largely depend upon the nature of forest ownership, particularly the socio-economic disposition of the owner. Multiplicity of the objectives complicates decision-making especially in respect of publicly owned forests. Till 1976 forestry was exclusively a state subject and the power to legislate vested entirely with the state governments. In 1976, forestry was brought under the concurrent list empowering the central government to enact legislation. In the absence of a state forest policy, in theory, planning and management continue to be guided by the National Forest Policy of 1952. The policy identified the following vital national needs, namely:

"(1) the need for evolving a system of balanced and complementary land use, under which each type of land is allotted to that form of use under which it would produce most and deteriorate least;

(2) The need for checking

(a) denudation in mountainous regions on which depends the perennial water supply of the river systems whose basins constitute the fertile core of the country;

(b) the erosion progressing along the treeless banks of the great rivers leading to ravine formation and on vast stretches of undulating waste lands depriving the adjoining fields of their fertility;

(c) invasion of sea-sands on coastal tracts, and the shifting of sand dunes more particularly in the Rajputana desert;

(3) The need for establishing tree lands, wherever possible for the amelioration of physical and climatic conditions and for promoting the general well-being of the people;

(4) The need for ensuring progressively increasing supplies of grazing, small wood for agricultural implements and in particular of firewood to release the cattle dung for manure to step up food production;

(5) The need for sustained supply of timber and other forest produce required for defense, communication and industry;

(6) The need for realisation of the maximum annual revenue in perpetuity consistent with the fulfilment of the needs enumerated above."

To achieve these objectives, a functional classification of forests into protection forests, national forests, village forests and tree lands has been suggested. The policy also indicates how conflicts between local and national needs will be resolved. It is stressed that those living in the neighbourhood of the forests should not have a greater claim on the forests and the products thereof than those who live away from the forests. Transfer of forest land for non-forestry purposes, particularly agriculture, is not to be allowed. The policy also briefly deals with some of the biotic problems in forest management. The need to have a close linkage between forestry and wood-based industries is emphasised.

The National Forest Policy merely provides a broad framework applicable to the whole country. The conditions prevailing in different states vary considerably warranting formulation of state forest policies taking into account local factors and the general guidelines provided in the national forest policy. However, none of the states in the country has drawn up a policy relevant to their situation and therefore the 1952 policy continues to be the only document which explicitly identifies the objectives of forest management.

Objectives given in the working plans is a reiteration of those given in the forest policy. For example the working plan for Konni Division (Pillai, 1970) lists out the following as the objectives of the plan, namely:

1. to protect the watershed area of Achencovil and Kallar rivers to minimise the evil effects from soil erosion, flood, silting up of streams and rivers and to regulate flow of water to the plains throughout the year;

2. to exploit mature and over-mature trees from the evergreen, semi-evergreen and deciduous forests with due regard to soil and water conservation;

3. to exploit and improve the degraded semi-evergreen and moist deciduous forests on a sustained yield basis and also in conformity with increased demand for timber and firewood;

4. to convert the areas with irregular mixed and less valuable crop into valuable teak plantations;

5. to improve the forests and to bring the same to normal condition as far as practicable;

6. to improve communications to enable cheap transport of forest produce, and

7. consistent with the above objectives, to obtain the maximum amount of revenue.

Objective (1) is consistent with the policy stipulation of checking denudation in mountainous regions to ensure perennial water supply while objectives 2 to 6 deal with enhancing wood production. Both in the National Forest Policy and those identified in the working plans, revenue maximisation is ranked last and should be consistent with other objectives. When objectives are mutually incompatible, neither the national forest policy nor the working plans indicate the criteria to be adopted for deciding the priorities. To what extent the objectives explicitly indicated in the national policy and the working plans are put into practice will depend upon the not so often explicitly indicated objectives of the government and the interest groups which influence decision-making. Multiplicity of objectives complicates management and no concrete guidelines have been provided to determine the trade-offs between different objectives when they become partially or fully incompatible. This has been one of the major problems in forest management in Kerala and will be discussed later.

4.2 Plans and Programmes

Policy objectives are translated into action through plans and programmes. Working plan is the most important tool for management of the forests in the study area. The five-year national development plans have also perceptibly changed the approach to forest management.

4.2.1 Working Plans

A working plan is a written scheme aiming at continuity of policy and action and deals with the technical, operational and financial aspects of forest management. The procedure followed for the preparation of working plans has been described in the Kerala Forest Code (Govt. of Kerala, 1973) which is a revised version of the Travancore-Cochin Forest Code (Govt. of Travancore-Cochin, 1952). The necessity of drawing up plans has been highlighted in the forest code as follows:

"The value and necessity for working plans drawn up on a scientific basis are unquestionable. Without such a definite scheme of operations founded on careful calculations and after personal inspection and examination, there is a serious risk of forest capital being unduly drawn and excessive cuttings being made which after a lapse of few years might lead to a partial collapse of forest revenue."

Working plans are medium term plans with a duration of 10 to 15 years, and it is usually prepared to cover the entire forests in a division, which is the unit of administration. Preparation of a working plan is usually entrusted to an experienced forest officer of the rank of a Deputy Conservator of Forests or an Assistant Conservator of Forests, who is designated as the Working Plan Officer. Based on the facts collected during a preliminary survey of forests, the working plan officer prepares a preliminary report. This contains:

(a) a short description of the forest area for which the plan is being prepared indicating the working circle;

(b) nature of demand that exists which needs to be met from the forests;

(c) outline of proposals to meet the demand, and

(d) short notes on the earlier working.

Proposals in the preliminary report are discussed with Divisional Forest Officer in whose jurisdiction the area falls, the Conservator of Forests, and the Conservator of Forests, Working Plans and Research. Once a general agreement is reached, work for the preparation of the plan commences. Field work includes assessment of growing stock, collection of data on environmental factors, present and future markets, local demand, availability of labour, etc. Stock and site quality mapping and enumeration are the major works involved in preparing an inventory of the growing stock. The working plan officer is assisted by supporting staff consisting of forest rangers, foresters, guards, draftsmen, compilers, office assistants, etc.

A working plan is prepared in the format prescribed in the forest code and is written in two parts. The background information, such as locality factors, characteristics of vegetation, utilisation of produce, statistics of growth and yield and results of past management, is given in part I. This forms the basis for prescriptions in part II which deals with future management. Here prescriptions are given for each working circle separately.

Once a plan is written up it is submitted to the Conservator of Forests, Working Plan and Research, who after scrutiny submits it to the Chief Conservator of Forests. If the Chief Conservator is satisfied with the plan he forwards it to the government for approval. Implementation of prescriptions is taken up after obtaining government sanction.

4.2.2 Five-year Development Plans

Unlike working plans which are written primarily on the basis of the condition of forests and the effect of past systems of management, five-year plans are drawn up on the basis of overall national and state level priorities. The broad sectoral priorities are decided by the Planning Commission taking into account the target growth rate of *per capita* income. Usually a task force constituted at the state level or national level helps the State Planning Board/Planning Commission in preparing the sectoral programmes. State level plans are scrutinised by the Planning Commission at the meeting of the National Development Council. State level proposals are modified according to the priorities identified at the national level and the availability of resources.

Although management of forests is under the state governments, indirectly the central government does influence management through various five-year plan schemes. Most of the matchwood, fuelwood, and industrial plantation programmes have been taken up with specific plan allocation and sometimes subsidies from the central government. Differences in the approach in preparing working plans and development plans resulted in considerable inconsistency between the prescriptions. Five-year plan targets seldom take into account local conditions. Since funds are made available on the basis of five-year plan programmes, working plan prescriptions tend to be ignored. Working plans have often attempted to resolve the problem, by revising the prescriptions in line with the trend in five-year plan programmes.

4.2.3 Implementation of Plans and Programmes

The responsibility for implementing prescriptions in the working plans and five-year plans rests with the Divisional Forest Officer. For each division an annual plan of operations based on the working plan and five-year plan is prepared which contains all the details of works to be undertaken in a year. Annual budget for the division is prepared on the basis of approved plan of operations. The consolidated budget for the department is prepared with the help of the divisional budgets. After scrutiny and necessary modifications by the finance department, the budget is placed before the legislature for

approval. Depending upon the expected income and expenditure of the government, allocation to the department may differ from what has been demanded, and sometimes programmes will have to be adjusted accordingly. Based on the annual plan of operations and budget provision, estimates are prepared for each work. Financial powers of the Divisional Forest Officer and the Conservator of Forests in respect of sanctioning estimates and incurring expenditure are laid down in the Forest Code. Once an estimate is sanctionned, the work is undertaken either departmentally or through the agency of contractors.

4.3 Forest Administration

The forest department is the main arm of the government which implements the various policies and programmes. The finance department has an indirect influence through controlling the budget allocation. Fig. 4.1 gives the pattern of organisation of the Kerala Forest Department. Most of the policy decisions are made at the level of the minister in consultation with the cabinet and on the advice of the Secretary to the Government and the Chief Conservator of Forests. At the Forest headquarters there are specific cells dealing with planning, preparation of working plans, silvicultural research, vigilance and evaluation, social forestry, wildlife management, general administration, etc. For general administration, forests in the State are allocated into circles, divisions, ranges, sections and beats. All activities such as protection, timber extraction, raising plantations and their after-care are undertaken by these administrative units. Preparation of working plans is the responsibility of the Conservator of Forests, Working Plan and Research and this is accomplished with the help of working plan officers. Foresters and Forest Guards are trained in the schools run by the State Forest Department while Forest Rangers and Assistant Conservators in the State Forest Service and the Indian Forest Service are trained in the colleges attached to the Forest Research Institute, Dehra Dun.

The Vigilance wing of the department attempts to ensure that the various works are carried out in accordance with the rules and regulations and renders assistance to the local staff in checking forest offences. The Silvicultural Research Officer has a small contingent of staff, primarily rangers and foresters, to carry out research on problems that are of immediate and direct relevance to the department. A social forestry wing under a Chief Conservator of Forests has been created recently to promote tree planting in farm lands, homesteads, barren and uncultivated areas, road margins and canal banks. Management of areas designated as sanctuaries and national parks is under the guidance of the Additional Chief Conservator of Forests who is assisted by Wildlife Preservation Officer and Assistant Wildlife Preservation Officers.

The Kerala Forest Development Corporation, a state government company, is another agency involved in forestry in the State. It was set up on the basis of the recommendations of the National Commission on Agriculture (Govt. of India, 1972, 1976) with the objective of enhancing production of raw material to the wood-based industries, particularly pulp and paper. The rationale for setting up such an autonomous corporation has been discussed in the previous chapter. Although initially the Corporation was mainly concerned with the production of pulpwood, it has diversified its activities by undertaking matchwood and cardamom plantations. All policy decisions are made by a government nominated Board of Directors consisting entirely of government officials (Chief Secretary to Government, Finance Secretary, Agriculture Secretary, Chief Conservator of Forest, etc.). Implementation of policy decisions is the responsibility of the Managing Director. Depending upon the work load, regions have been constituted under the control of Regional Managers. At the headquarters the Managing Director is assisted by an Operations Manager. Almost all the higher posts of the Corporation are manned by officials on deputation from the Forest Department.

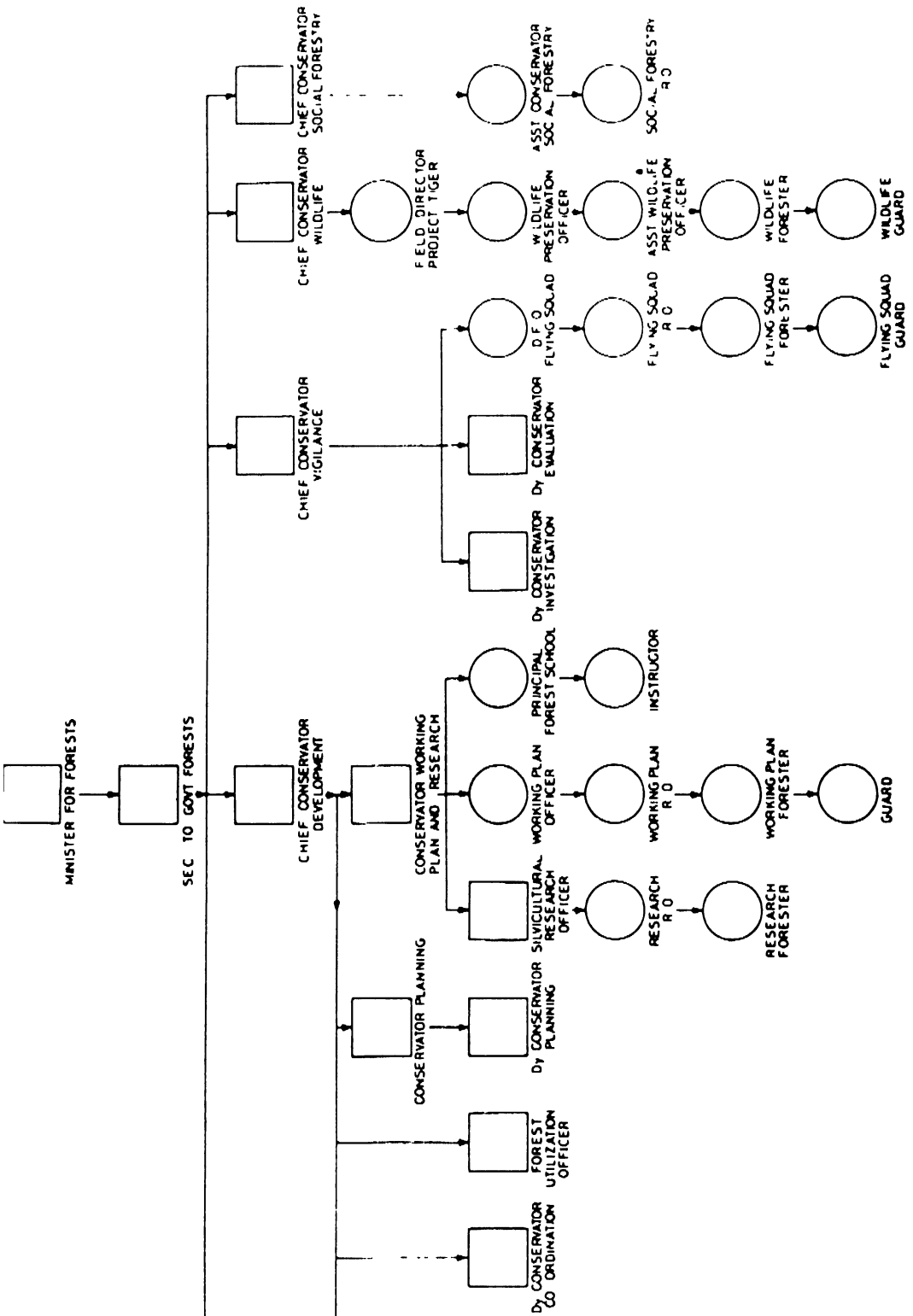


Fig. 4.1 Organisation Chart of the Kerala Forest Department

4.4 Forest Laws

Forest laws and regulations are important instruments in implementing the forest policy. Different acts and regulations applicable in Kerala are indicated below.

1. Kerala Forest Act, 1961: The Kerala Forest Act contains more or less the same provisions as the Indian Forest Act, 1927. The act primarily deals with the constitution of reserved forests, duties and responsibilities of the various government functionaries, acts forbidden in areas constituted as reserved forests, punishments and penalties to those who violate the rules, procedure for detecting and charging an offence in a court of law, etc. Setting fire, felling, lopping, girdling, uprooting, tapping, debarking and burning trees, damaging boundary marks, clearing and cultivation are all offences as per the act. Punishment for these may be up to three years imprisonment or fine up to Rs. 1 000 or both. The Timber Transit Rules framed as per the provisions of the Forest Act regulates the movement of timber and other forest produce. As per these rules transport of forest produce without a valid permit issued by a forest officer or any such authorised person will be an offence.

2. The Cattle Trespass Act, 1971: This act lays down procedure for dealing with cattle trespassing into forest areas closed to grazing.

3. Kerala Forest (Vesting and Assignment) Act, 1971: Up to 1971 the private forests in the State were governed by the Madras Preservation of Private Forests Act, 1948. In 1971 through promulgation of an ordinance and followed by the Kerala Private Forests (Vesting and Assignment) Act, the government took over the private forests without paying any compensation. The enactment was brought as a land reform and stipulates the assignment of part of the vested forests suitable for agriculture to the landless while the rest is to be managed in accordance with the principles of conventional forest management.

4. The Wildlife Protection Act, 1972: The Kerala Forest Act does contain provisions which forbid hunting, fishing, shooting, trapping and poisoning of animals in reserved forests. Realising the need to give better protection to wildlife both within and outside the reserved forests, the Wildlife Protection Act was enacted in 1972. The act prescribes rules regarding hunting of wild animals and declaring forest areas as national parks, game reserves and closed areas.

5. The Kerala Forest Produce (Fixation of Selling Price) Act, 1978: Most of the plywood, matchwood and pulp and paper units in the State were obtaining wood supply from the Forest Department at subsidised rates under a quota system or on the basis of long-term agreements. Very often these rates were unreasonably low and did not cover the cost of production. This act attempts to rationalise the pricing methods. As per the act, a committee of experts appointed by government recommends the appropriate prices based either on the prevailing market prices, or the cost of producing raw material. Government can, if required, exempt the State-owned companies from the operation of the act. A provision is also made that 10 percent of the selling price is to be utilised for forest development.

6. Forest (Conservation) Act, 1980: This is one of the most important legislation enacted by the Central Government. The act stipulates that no state government shall disreserve any reserved forest without the prior approval of the Central Government. It also stipulates the constitution of a committee to advise the Central Government on the appropriateness or otherwise of disreservation proposals made by the state government.

4.5 Summary and Conclusions

The framework for forest management in the study area and the State is described in this chapter. In theory the National Forest Policy of 1952 gives the general objectives of management and these are more or less repeated in the working plans also. Working plan is the most important tool of management, and they are drawn up systematically on the basis of information on locality factors, characteristics of vegetation and results of past working. Advent of five-year development plans drawn up for the economy as a whole has however brought about changes in the approach to management. Especially during initial stages, considerable inconsistency existed between the programmes and targets prescribed in the working plans and five-year plans. Despite the efforts to take the trend in general planning into account at the time of preparation of working plans, the inconsistency persists. The Forest Department continues to be the principal agency for implementing the plans and programmes. Based on the recommendations of the National Commission on Agriculture, the Kerala Forest Development Corporation has been formed primarily to undertake plantation programmes to meet industrial requirements. Being an autonomous body, the Corporation has the advantage of flexibility. Further it faces no serious financial constraints due to easy access to institutional finance.

Forest laws defining the relationship between man and forests are important instruments in implementing a forest policy. The Forest Act and the rules framed thereunder primarily deal with the protection of forests from biotic factors, particularly illicit removal of forest produce, encroachment, grazing of cattle, hunting, etc. To what extent the general approach described here holds good in practice is described later.

CHAPTER 5

MANAGEMENT OF EVERGREEN FORESTS

Evergreen and semi-evergreen forests occur over an area of about 1 030 km^2 and account for 58 percent of the forests in the study area. About 84 percent of these are found in Ranni and Thenmala Divisions. These forests play an important role in the production of wood and non-wood products and in providing non-marketed benefits. Current management practices aimed at realising the above benefits are discussed in this chapter.

5.1 Objectives of Management and Organisation

Evergreen and semi-evergreen forests in the study area are managed to achieve the following objectives:

1. Protection of steep slopes and catchment areas of rivers to prevent soil erosion and to regulate and improve supply of water to rivers and streams;

2. Wood production by removing the mature and over-mature trees to meet the demand from industries and other consumers without adversely affecting the evergreen character of vegetation;

3. Production of non-wood products such as canes, reeds and minor forest products; and

4. Improvement of the stocking of commercially important species by appropriate silvicultural practices (Ashary, 1967; Pillai, 1974; Achuthan, 1982).

Attainment of these objectives requires specific sets of treatments and to facilitate this, forest areas are allotted to working circles. A working circle is defined as a forest area forming the whole or part of a working plan area organised with a particular objective and under one silvicultural system and one set of prescriptions. Working plans dealing with evergreen forest management identify two principal working circles, namely: (1) protection working circle, and (2) selection working circle. Allocation of forests into different working circles is guided by a number of factors, such as accessibility, topography, character of vegetation, marketability of species, etc. Easily accessible areas are allotted to the selection working circle for wood production. Not unusually, evergreen forests have been allotted to conversion working circles and clear-felled and planted with species such as teak and eucalyptus. In theory, protection working circle should comprise all areas which should be protected so as to maintain their watershed value or other benefits. However, in practice it consists of inaccessible areas which have not been included in any other working circle.

When two objectives are compatible, no zoning is necessary and working circles can overlap. This is the case with working circles dealing with collection of reeds, canes and minor forest products.

Table 5.1 gives the major objectives of management and the area allocated to different working circles in the study area.

Table 5.1

Constitution of Working Circles (Area in km^2) 1/

Objectives	Working Circle	Area (km^2)	Remarks
1. Watershed protection 2/	Protection Working Circle	898.32	Residual area after identifying selection and conversion working circles
2. Wood production 3/	Selection Working Circle	655.00	Boundaries are well defined
3. Collection of reeds	Reed Working Circle	All reed bearing areas	Overlaps with protection and selection working circle
4. Collection of canes	Rattan Working Circle	All rattan bearing areas	Overlaps with protection and selection working circle
5. Collection of minor forest produce	Minor Forest Produce Working Circle	1 784.00	Covers all forests and overlaps all other working circles

1/ Compiled from the current working plans applicable to the area

2/ Protection working circle also includes parts of moist deciduous forests on ridge tops and such inaccessible areas

3/ Wood production objective is also achieved from areas included in the conversion working circle

Management practices adopted to achieve the different objectives are described below.

5.2 Management for Wood Production

Forests allotted to the selection working circle are managed under a polycyclic system, usually referred to as selection system. This involves: (1) removal of mature and over-mature trees from the area that could be profitably extracted, (2) augmenting natural regeneration where it is sparse or absent and its tending, and (3) maintaining the evergreen character of the vegetation to prevent site degradation. Felling is restricted to trees selected on the basis of certain predetermined criteria, such as girth and marketability.

For organisational convenience one or more felling series are identified in a working circle. A felling series is defined as a forest area forming the whole or part of a working circle and delimited so as to: (1) distribute felling and regeneration to suit local conditions, and (2) maintain or create a normal distribution of age classes or age gradations. Yield determination is done separately for each felling series. Currently, there are 17 felling series in the study area where selection felling is adopted.

5.2.1 Principles of Management

Harvesting timber and post-harvest operations such as tending existing regeneration, supplementing through artificial means, weeding, and thinning pole crops are the important items of work under a true selection system.

5.2.1.1 Timber Harvesting

Timber harvesting from a natural stand requires answers for when to cut, where to cut and how much to cut. Yield regulation under the selection system adopted in the study area is described below.

1. Conceptually the question when to harvest is linked to the fixation of rotation. Given a species-specific growth rate, rotation influences the size of trees and the volume of harvest. In addition to marketability, silvicultural requirements, particularly the ability to produce adequate quantity of seeds to facilitate natural regeneration also should be taken into account. The rotation prescribed varies from 120 years in Thenmala Division, (Achuthan, 1982) to 180 years in Ranni Division (Pillai, 1974). Although the species composition in both the forests is identical, difference in the assumed girth increment has led to two different rotations. In the former case the average annual girth increment has been assumed as 1.5 cm while that for Ranni has been taken as 1.0 cm. In both cases, therefore, the trees attain an average exploitable girth of 180 cm. Interestingly, in a polycyclic system rotation has very little relevance in deciding the time of harvest. Primarily it is a decision at the margin, i.e. whether to harvest now or to postpone it for a few more years. Nevertheless, rotation has some indicatory value.

2. To prevent over-exploitation checks are exercised on the basis of area, exploitable girth, and number of trees. Felling in a year is limited to the annual coupe. Area of the annual coupe is estimated as:

$$a = \frac{A}{F}$$ where a = area of the annual coupe; A = total extent of the felling series; F = felling cycle in years

Felling cycle is the interval that elapses between successive fellings in the same area. The number of years that trees in the pre-exploitable class take to reach the exploitable class is an important factor in determining the felling cycle. It is assumed that during the interval between two successive fellings, the co-dominants released from suppression will put on adequate growth and become harvestable. Underlying this assumption is the belief that the forests treated are normal or near normal. However, in most unworked natural forests normality is completely lacking and there is a preponderance of mature trees which put on little increment. Susceptibility of these trees to decay and other damages necessitates early removal which suggests the adoption of a short felling cycle. A shorter cycle, however, increases the annual working area, leading to several

administrative and organisational problems. In the study area, for all felling series, a cycle of 15 years has been prescribed.

A control based on diameter (girth) involves fixation of an exploitable girth below which trees may not be felled. The nature of market demand is an important factor that determines the exploitable girth. In the first working plan for Ranni Division (Pillai, 1961), exploitable size was fixed at 210 cm and above '... taking into consideration the size at which the species tend to become unsound, the size which could be attainable in the locality, the quantity of mature stock available, the capacity of the market to absorb the timber extracted and above all the possibility of providing a sustained yield' (p. 74). Increasing demand from wood-based industries, particularly plywood, led to the downward revision of exploitable girth to 180 cm (Pillai, 1974). Table 5.2 gives the exploitable girth adopted in Thenmala Division, excepting Kallar and Aramba series in which case 250 cm has been fixed for all species. Due to inaccessibility these two areas have not been worked in the past and therefore there is a preponderance of trees in the higher girth classes and hence the higher girth limit.

A further check is exercised by prescribing the number of trees that can be removed from unit area. Two methods are in vogue for fixing the exploitable number of trees. More often it is prescribed arbitrarily based on past practices and this seems to be the case in most divisions where selection felling is followed. The number of trees that can be removed varies from 8 to 12 per hectare. The current working plan for Thenmala Division stipulates the removal of 12 trees per hectare. A more sophisticated approach is to determine the harvestable number as a percentage to the total number of trees in the exploitable class, including those that are likely to reach this class during the felling cycle, using the Smythie's Safeguarding formula.

$$Y = \frac{X}{I - \frac{X}{2}} \; 100$$

where Y = Number of trees that can be removed expressed as a percentage of the number of trees in the exploitable class and those reaching the exploitable class during the felling cycle

I = Number of trees in the exploitable class (Class I)

X = Number of trees that reach the exploitable class (Class I) from the pre-exploitable class (Class II) during the felling cycle. This is derived as

$x = f/t$ (II - Z percent of II)

f = felling cycle

t = time taken by trees in the pre-exploitable class to reach the exploitable class

Z = mortality percentage during the passage from Class II to Class I

II = Number of trees in the pre-exploitable class

Table 5.2

Exploitable Girth for Selection Felling in Thenmala Division

Species	Selection girth
Hopea parviflora Dipterocarpus indicus Dipterocarpus bourdilloni Artocarpus hirsutus Hardwickia pinnata Lophopetalum wightianum Vateria indica Tetrameles nudiflora	210 cm and above
Gluta travancorica Toona ciliata Mangifera indica Dysoxylum malabaricum Chukrasia tabularis Bischofia javanica Antiaris toxicaria Ailanthus malabarica Calophyllum tomentosum	200 cm and above
Alstonia scholaris Artocarpus lakoocha Mesua nagassarium Poeciloneuron indicum Persea macrantha Canarium strictum Dichopsis elliptica Sterculia alata Trewia nudiflora	180 cm and above
Polyalthia fragrans	150 cm and above
Vitex altissima Xanthoxylum rhetsa Euodia lunu-ankenda	120 cm and above

Adoption of the Smythie's Safeguarding formula requires information on time taken to move from the pre-exploitable class to the exploitable class (t), and the percentage of mortality during transition (Z). In the absence of such information, application of the formula involves assumptions on these parameters. For Ranni Division, Pillai (1974) estimates the number that can be removed as 38 percent of the trees in the exploitable class or about 14 trees per hectare. However, this number is revised upwards to 20 on the argument that ".... the development of science and technology has created a situation that more number of species which were considered unsuitable can be put to good use and that in future all species will be put to one use or the other" (p. 198). It is asserted that such drastic openings that may result from this is unlikely to affect the evergreen character.

Selection felling. Most often the distance between two marked trees is far less than what is prescribed

The following rules have been prescribed for selection felling.

1. No trees within a radius of 20 metres from a marked tree should be felled.

2. Marking should be restricted to sound trees.

3. Felling should commence from one end of the coupe and progress systematically to the other end.

4. Unmarked trees broken during timber extraction operations should be converted if the species and sizes are saleable.

5. Trees should be felled in such a way that damage to adjoining trees and regeneration is minimised.

6. All damaged seedlings will be cut back at the ground level.

7. Felled trees should be converted into logs in such a way as to obtain the maximum output.

Openings created by selection felling are very often occupied by profuse weed growth. See the emerging Macaranga and Eupatorium.

5.2.1.2 Timber Harvesting in Practice

Although about 30 species are listed as suitable for felling, in practice a disproportionately large number of trees belonging to species which are in gread demand are removed. The species and number of trees marked depend on the objectives relevant immediately. When railway sleepers are to be supplied, marking is invariable limited to species such as Dichopsis elliptica, Cullenia exarillata and Mesua ferrea. Table 5.4 gives the percentage distribution of trees belonging to different species in the total number of exploitable trees (of and above 180 cm girth) and the distribution of number of trees actually marked in selected coupes in Ranni Division.

Table 5.4

Selection Felling in Evergreen Forests

Species	Percentage distribution in the total number of exploitable trees	Percentage distribution of the number of trees actually marked
1. Dichopsis elliptica	30.6	75.7
2. Cullenia exarillata	24.0	16.1
3. Mesua nagassarium	24.1	7.1
4. Vateria indica	6.1	0.2
5. Other commercially important species (22 Nos.)	15.2	0.9
Total	100.0	100.0

Source: Compiled from working plan and marking register

Dichopsis elliptica, Cullenia exarillata and Mesua nagassarium yield good quality railway sleepers, and often extraction amounts to more or less complete removal of trees belonging to these species above the exploitable diameter. Mesua ferrea is a very hard timber, and due to this workers and contractors engaged for sleeper extraction tend to prefer easily workable species. When demand for veneer logs is to be met, marking is limited to prime veneer species, particularly Vateria indica, Dipterocarpus bourdilloni and Hardwickia pinnata. In the Rockwood Felling Series in Thenmala Division, these three species account for about 6.2 percent of the total number of trees in the exploitable class; however, 56 percent of the trees extracted belong to these species.

Thus, despite working plan recommendation for spreading the removal between the various species acceptable in the market one or two species account for bulk of the actual removals. This is because selection felling is done in an area for meeting the demands of a particular user. The preferences of the single user gets reflected in the actual marking in an area.

5.2.1.3 Systems of Timber Extraction

Two systems of timber extraction are prevalent in the study area. Under the mellabhom system, marked trees are entrusted to user industries for felling, conversion and transport to factory site. Before removal of logs from the forest they are measured and value is realised as per the rates fixed under the Kerala Forest Produce (Fixation of Selling Price) Act, 1978.

Mellabhom system is appropriate when user industries are sufficiently big enough to independently undertake timber extraction operations. Small-scale units in the State are not in a position to take up logging. Their needs are met through the supply contract system. Under this, the department engages a contractor to collect and transport logs to government depots on payment of an agreed rate. Timber so obtained is then allotted to user industries, who remove them on payment of the price including the working cost. Extraction of railway sleepers is also taken up under the supply contract system.

From 1975 onwards, lops and tops of trees felled and damaged during timber extraction are being collected separately. Rejections down to 60 cm mid-girth, but which cannot be utilised as logs are permitted to be collected by industries on payment of 70 percent of the rates applicable for logs. A separate contract is fixed up for this after completion of the main timber extraction operations. Lops and tops are usually collected only from areas which are easily accessible.

5.2.3 Regeneration Operations

Although regeneration operations form an essential component of any silvicultural system, it gets only scant attention under the selection system practised in the study area. It is assumed that gaps created by felling of mature trees will be closed naturally by regeneration that springs up and the favourable light conditions will facilitate the movement of co-dominant trees to the dominant category during the interval that elapses between two successive fellings. Experience, however, indicates that these assumptions are not valid. Natural restocking is inhibited by the following factors:

1. Absence of adequate natural regeneration of commercially important species in the form of seedlings and saplings;
2. Heavy felling damage to poles, saplings and even unmarked mature trees;
3. Competition from colonisers which come up in the openings.

Regeneration of valuable species is generally poor in most of the evergreen forests. Although only 8 to 12 trees are marked for felling from one hectare, damage to adjoining trees during felling is very heavy. Trees marked for removal belong to the top canopy and during felling they inflict heavy damage to a large number of trees in the middle and lower canopies. Openings therefore tend to be far in excess of what is regarded as ideal. Micro-climatic conditions on the forest floor is completely changed facilitating the emergence of heliphilous colonisers such as Macaranga peltata, Leea sambucina and Trema orientalis. Gaps are sometimes colonised by grass, reeds and Eupatorium which preclude establishment of seedlings of desirable species. Increased fire hazard inhibits regeneration of fire tender evergreen species. Therefore regeneration is too slow to establish or totally absent in the evergreen forests (Karunakaran, 1982).

Attempts to regenerate evergreen forests have a long history. Iyer's working plan report (1923) for Kulathupuzha and Yeroor forests , part of which now forms the Thenmala

Formation of extraction road in evergreen forest

Elephants play a crucial role in logging and short distance haulage

Division, contained prescriptions for augmenting regeneration. One of the prescriptions was to clear the undergrowth and to dibble seeds of Hopea parviflora, Dysoxylum malabaricum, Vitex altissima, etc. in prepared ground. Proposals for promoting natural regeneration in unworked localities included clearing undergrowth for a radius of 40 m around each parent tree and opening up the canopy to permit adequate light. These prescriptions were, however, not implemented.

In the recent working plans several prescriptions have been made to improve and augment regeneration. Weeding in patches and cutting down all unwanted growth have been recommended in Pillai's (1974) working plan. Areas where stocking of seedlings is poor are to be planted up with seedlings collected from adjoining forest areas. Where this is not possible, seedlings are to be raised in nurseries and planted out before the onset of monsoon. The species recommended for planting are Dipterocarpus indicus, Dipterocarpus bourdilloni, Artocarpus hirsutus, Toona ciliata, Dysoxylum malabaricum, Hardwickia pinnata, Lophopetalum wightianum, Vateria indica, Canarium strictum, Gluta travancorica and Persea macrantha. Casualty replacement in the 2nd and 3rd years and two to three weedings during the first three years have been prescribed. During the 4th and 7th years weeding, cleaning and climber cutting are to be carried out. To improve light conditions, unwanted species are to be removed by girdling.

A five-year plan scheme 'Intensification of management' is being implemented in the study area to improve and augment natural regeneration. Under this scheme annually about 40 to 50 hectares of felled evergreen forests are taken up for enrichment planting. Important operations carried out during the first year are: (1) clearing weed growth, (2) girdling unwanted trees, (3) collection of seedlings from adjoining areas, (4) planting them in cleared areas at an espacement of 2.5 x 2.5 m or 3 x 3 m, and (5) one weeding. During the second and third years one weeding is carried out. Cost per hectare for establishment and maintenance during the first three years is given in Table 5.5.

Table 5.5

Cost of Regeneration Operations in the Evergreen Forests

Year	Operations	Cost/ha[1/] (in Rs.)
1	Weeding, cleaning, girdling and planting	1 155.00
2	Weeding	215.00
3	Weeding	105.00

1/ Based on the 1982 wage rates (See Appendix 1)

Source: Compiled from the records of the Forest Department

Areas regenerated under the scheme are better stocked with seedlings and saplings of commercially important species than untreated areas. The major drawbacks of the scheme are:

1. It concentrates on augmenting regeneration during the first three years, and little attention is paid to establishment and growth during subsequent years. No weeding or cleaning is carried out during later years. If canopy opening is excessive, weed growth will be very dense causing suppression of seedlings and saplings. If it is too little, light conditions should be regulated by gradually removing the under-storey and middle-storey trees. Such discriminating and careful treatment is necessary to regenerate evergreen forests. In the absence of continuous attention, even if initial establishment is satisfactory, success cannot be ensured in the long run.

2. Area treated under 'Intensification of management' is limited to a small fraction of that taken up for timber exploitation. Table 5.6 gives the area subjected to selective felling and regeneration in Ranni forest Division.

Table 5.6

Selective Felling and Regeneration Operations in Ranni Division

Year	Area under selection felling (ha)	Area regenerated (ha)
1975-76	461	Nil
1976-77	435	20
1977-78	766	Nil
1978-79	839	20
1979-80	1 148	20
1980-81	1 276	30
Total	4 925	90

Source: Compiled from the records of the Forest Department

In Thenmala Division, the average area taken up annually for regeneration is about 50 hectares while selective felling is carried out over an area of about 400 to 500 hectares. Large-scale regeneration operations encounter several technical, financial and managerial problems. Success of regeneration greatly depends on the care and attention given during the early years and supervision is a crucial factor in this. Scattered nature of the work and inaccessibility make it extremely difficult to supervise regeneration work. Vast tracts of selectively felled forests remain untreated, jeopardising the ability of the system to yield a sustained supply of timber.

To summarise, the so-called selection system practised in the evergreen forests amounts to nothing more than selective removal of commercially valuable trees having an immediate demand. One can, therefore, only agree with the observation made by Troup (1916) that '.... the quasi-selection system of India does not conform to the definition, in that it takes little or no account of the attainment of the normal forest and the establishment of regeneration to the normal extent while in too many cases it does not even consider the silvicultural requirements of the species' (p. 51). Selection system that developed in continental Europe is a highly skill-intensive system where each sapling, pole and tree gets individual attention. In contrast, what is practised in the study area is an extensive system of extraction of timber and has no similarity with the true selection system except in name. To what extent the system can ensure a sustainable supply of wood is discussed later.

5.3 Management for Non-wood Products

All non-wood products are grouped as minor forest products (MFP). This includes honey, wax, cardamom, canes, reeds, medicinal plants, gums, resins, tanning materials and fruits of several species. When any one of them becomes commercially important, its management is dealt with separately by constituting a working circle. For example reeds and rattans (canes) were earlier included under minor forest products. Establishment of pulp and paper industry created a market for reeds, and subsequently reed was taken out of the list of minor forest products to be managed under the reed working circle. Rattan (cane) is an important raw material in furniture making and its high value has led to its separation from the general MFP list and management under the rattan working circle. Since both, reeds and canes occur in scattered patches over the entire area, working circles dealing with their management overlap other working circles.

5.3.1 Minor forest products

As the name itself indicates, minor forest products (MFP) have received only minor attention in forest management. Working plans and forest resource surveys which are more concerned with wood production have completely neglected the development of minor forest products and consequently their full potential is not being realised. Apart from indicating the organisational aspects of collection, working plans do not contain any prescriptions for augmenting their stock. The right to collect and remove various items is leased out annually, either to hill-tribe cooperative societies, or, in the absence of such societies, to contractors. In the former case the lease rent is based on negotiation, and to encourage societies to undertake the work, the rate fixed is lower than the market rate. Marketing of products is undertaken by an apex society, namely the Harijan-Girijan Cooperatives Federation. The rates payable to societies by the apex society for the different products are fixed by a state level committee.

5.3.2 Cardamom Cultivation

Cardamom is the dried fruit of Elettaria cardamomum, which occurs naturally as an undergrowth in evergreen forests in the Western Ghats. Wild cardamom is one of the items included under MFP. The forest department had raised a cardamom plantation at Konni in 1869. However, no information is available on the later history of this plantation. By 1981 the total area under cardamom plantations in Kerala State was 56 380 hectares accounting for about 60 percent of the total area in the whole country. Most of the plantations are under private ownership. During 1969 to 1973 the forest department raised 145 hectares of cardamom in the Pachakkanam forests in Ranni Division. When the Kerala Forest Department Corporation initiated a cardamom plantation project in 1976, these plantations were handed over to the Corporation for better management. Including this, the Kerala Forest Development Corporation now owns about 1 025 hectares of plantation.

Cardamom plantations. Often clearing for shade is excessive.

Cardamom cultivation has been taken up with the objective of productively utilising the evergreen forests. On account of the very low proportion of marketable trees and poor accessibility, the scope for commercial utilisation of evergreen forests is limited. Intensive production of non-wood products, such as cardamom, is conceived as a viable alternative.

In addition to the usual activities associated with raising plantation of any species, regulating shade is probably the most crucial operation in cardamom cultivation. This involves the removal of selected trees, particularly in the low and middle canopies. Cardamom thrives well only under optimal light conditions; too much or too little shade inhibits growth.

The Pachakkanam estate is under the charge of a Regional Manager. There are about 630 workers permanently employed on the project. Sri-Lankan repatriates of Tamil origin constitute the main work force. One of the attractions for employing repatriate workers is that the Department of Rehabilitation, Government of India gives a grant of Rs. 20 000 to Rs. 35 000 to provide employment for a family of two.

Cardamom starts yielding fruits from the 4th year. Although it may continue to yield for about 30 years, output is at its peak from the 5th to 12th years. The average annual yield from a well-maintained plantation is about 50 kg/ha. Since some of the plantations raised by the Forest Development Corporation are yet to reach maturity, the average yield obtained from the Pachakkanam estate is only about 6.5 kg/ha.

Long-term viability of cardamom cultivation in evergreen forests depends crucially on: (a) the economics of cultivation, which is dependent on world prices, and (b) maintenance of appropriate micro-climatic conditions. World market prices are subject to considerable year to year fluctuations. Being a non-essential good, demand for cardamom is inelastic. Also, on account of the time lag involved between investment and production, in the short run supply is not responsive to prices. Under such circumstances supply at a given time determines the prices at that point. Hitherto, India had a near monopoly in production of cardamom. Guatemala which has extensive untapped natural forests and where labour is cheap, has however emerged as a major competitor, and indications are that they may soon capture some of the traditional markets dominated by India. Substitution of cardamom extract in lieu of cardamom powder in bakery products is likely to reduce the total demand. All these indicate that one cannot be too optimistic about the long run economic viability of cardamom.

Sustainability of cardamom cultivation is yet an incompletely understood aspect. Survival and growth of cardamom plants are crucially dependent on maintaining ideal light and moisture conditions. But the very process of cardamom cultivation could have long-term adverse effects. Clean weeding carried out precludes establishment of regeneration of tree species. Gaps created due to death of trees in the top canopy seldom get covered by regeneration and this could affect productivity in the long run.

Whether cardamom cultivation and wood production can be carried out simultaneously cannot be easily answered. Hitherto, no attempt has been made to manage a given area for both the objectives simultaneously. For most of the planters, whether in the public or private sector, cardamom is the major crop, and no income is realised from timber obtainable through shade regulation operations. Compatibility of these two activities are discussed later.

5.3.3 Reed Collection

Evergreen and semi-evergreen forests in the study area contain two species of reeds, Ochlandra travancorica and O. scriptoria, which occur along river and stream banks. Reeds also colonise clearances in evergreen forests. They form an important raw material for traditional and modern industries. The Kerala State Bamboo Corporation organises collection and supply of reeds to households and small-scale industrial units engaged in traditional industries such as mat-weaving and basket-making. Other major reed-users in the area are: (1) the Punalur Paper Mills, and (2) the Newsprint Unit of the Hindustan Paper Corporation, a public sector undertaking.

Reed bearing areas are constituted into reed working circles and this overlaps other working circles such as selection and protection. To distribute felling evenly in different ranges, a working circle is sub-divided into felling series. Mature reed culms are removed selectively. A four-year felling cycle ensures that the area gets adequate rest after felling. The following felling rules have been prescribed for extraction of reeds.

1. No culm less than two years should be cut and removed,
2. All new culms and 25 percent of the old culms should be left intact,
3. No clump should be clear-felled except after flowering and seeding have been completed,
4. A culm should be cut as low as possible leaving one internode above the ground,
5. Cutting should begin from the side opposite to where new sprouts are emerging.

The average quantity of reeds removed annually from the study area is about 14 000 tons. Since the Newsprint units have gone into production only recently, removals will substantially increase in the next few years. Gregarious flowering of reeds takes place at about the 7th year after which the whole clump dies. No attempt is being made to artificially regenerate reeds and there is complete reliance on natural regeneration. New culms sprout from the rhizomes, and if felling rules are strictly adhered to this will ensure a more or less even supply every year. However, due to the scattered nature of work, supervision is extremely difficult. Since workers are paid on the basis of outturn, often there is a tendency to clear-fell entire clumps. This is an important factor that contributes to the depletion of reed resources the other being diversion of forest land for non-forestry purposes - for agriculture, construction of river valley projects, etc.

5.3.4 Collection of Rattans (canes)

Evergreen and semi-evergreen forests in the study area contain a large number of Calamus species (canes) which form an important raw material in the manufacture of furniture and other fancy items. Important species of Calamus found in the study area are C. rotang, C. pseudotenius, C. rheedi, C. viminalis and C. travancorica. As in the case of reeds, canes also occur scattered in the forests and therefore the rattan working circle overlaps other working circles.

Being a minor forest produce, hitherto no attempt has been made to estimate the growing stock and annual yield. Currently, a 4-year felling cycle is prescribed. Each felling series is divided into 4 coupes and during each year one coupe is worked and the other three coupes are given rest. Although felling rules prescribe the removal of mature canes only, due to difficulties in supervising the work, such provisions cannot be enforced. Canes that occur in easily accessible areas are often clear-felled, while those in inacessible areas remain unexploited.

No serious attempt has been made to regenerate canes artificially. In Kallar Valley in Thenmala Division, an experimental plot has been established. It appears that canes thrive well under shade conditions and too much of opening hampers growth.

5.4 Watershed Protection

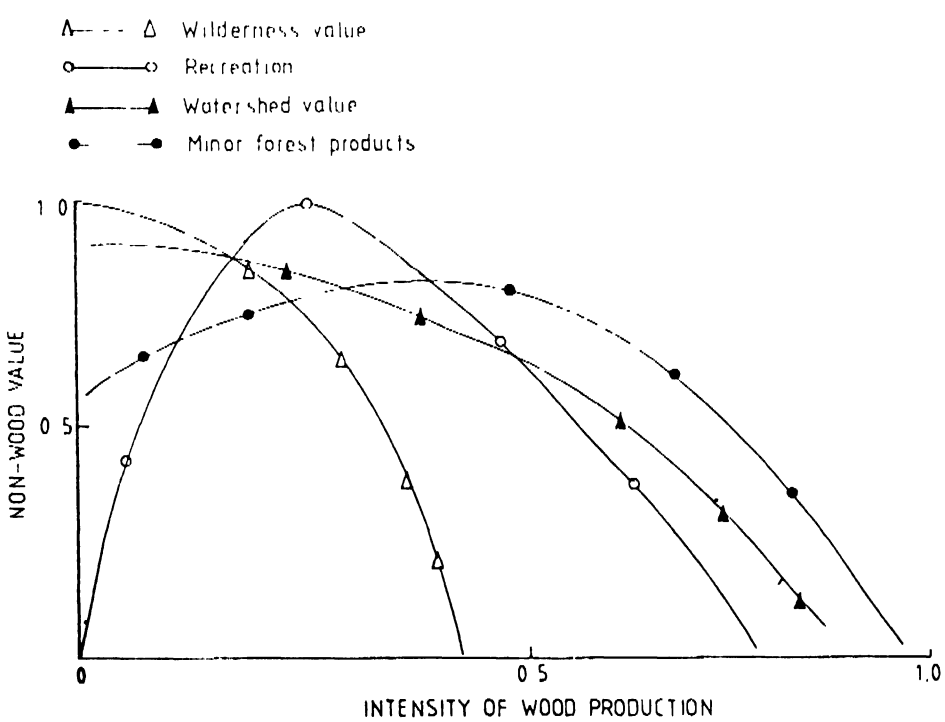
All inaccessible forests located in difficult areas are grouped under protection working circle with the objective of affording protection to catchment areas of rivers and streams to maintain an even flow. Inaccessibility forbids profitable timber extraction and this is a compelling reason for not utilising the area for wood production. Although watershed protection is a major objective, working plans contain no prescriptions to enhance the protective values.

5.5 Discussion and Conclusions

From the foregoing discussion it is clear that management of evergreen forests is beset with a number of problems arising from the multiplicity of uses and the difficulties in identifying the most appropriate alternative for a given situation. Some of the uses are mutually compatible while others are partially or completely incompatible. Compatibility also has an inter-temporal dimension, in that use of forest for a particular purpose at a given point of time may affect the same use at other points of time.

It is difficult to pair the different uses as strictly compatible or strictly incompatible. Primarily compatibility or otherwise depends on the intensity of use. At low intensities of use, two alternatives could be fully compatible, while incompatibility may arise on account of the intensive use for realising any one of the objectives. Fig. 5.1 indicates the relationship between wood production and other uses of evergreen forests.

Fig. 5.1



5.5.1 Wood Production and Watershed Protection

Wood production and watershed protection are mutually incompatible uses. Intensive use of forest land for one of the purposes directly reduces benefits from the other. At low intensities of wood production, an evergreen forest ensures more or less complete protection to the catchment. With increasing intensity of wood production watershed values decline at a rapid rate. Where evergreen forests have been clear-felled and converted into plantations of teak and eucalyptus, soil erosion has increased, especially due to faulty cultural practices. Incompatibility between these two uses has been attempted to be resolved by zoning into selection working circle and protection working circle. As discussed earlier, wood production is the dominant use in areas allocated to the selection working circle while watershed protection gets priority in forests included under the protection working circle.

It is important to examine the criteria adopted for allocation of forests into different working circles. Ideally, protection working circle has to be constituted on the basis of terrain, soil characteristics, rainfall intensity and watershed values realisable from the area. However, in identifying the protection working circle none of these factors seems to have been taken into consideration. If allocation of a forest for any specific use is based entirely on technical and environmental considerations, the area under the different working circles should remain constant. This is not the case. Area allocated for each working circle undergoes changes with each revision of the plan. Economic considerations such as demand for wood and accessibility are major factors influencing allocation of an area to a particular zone while characteristics of the land and forests seems to have only a subsidiary role. Almost all working plans dealing with management of evergreen forests include easily accessible areas under selection working circle while the residual area which is inaccessible or contains poor growth, are included under protection working circle. The general trend as regards the progressive change in area under different working circles is indicated in Fig. 5.2.

Until the beginning of this century, inaccessibility and lack of knowledge on the utilisation of various species, enabled evergreen forests to remain unexploited. Establishment of match and plywood manufacturing units and expansion of railway and road network enhanced the utility and accessibility of these forests. Construction of the Trivandrum-Shencottah road and the Quilon-Shencottah railway line through Aryankavu Valley facilitated intensive exploitation of forests in the valley. Most of the earlier teak plantations in Thenmala Division were raised in this valley clear-felling the natural forests. In contrast, the adjoining Shendurney valley remained comparatively less accessible, and some of the interior areas remain so even today. This has favoured the adoption of a selective felling system. Forests in the Kallar Valley and the higher reaches of Ranni Division remained inaccessible for a very long time, and they were mostly included under the protection working circle. No timber extraction could be carried out even when they were earmarked for selection felling. However, with the completion of the road connecting Kallar Valley with Achencovil in 1967, all accessible forests in the valley were converted into teak plantations. In Ranni Division, also areas included under protection working circle in the earlier plans were taken up for selection working and sometimes even converted into plantations on improvement of accessibility subsequent to the road construction undertaken for the Sabarigiri Hydro-electric project. The distribution of area under different working circles as proposed in successive working plans is represented in Fig. 5.3.

Fig. 5.2

CHANGE IN THE AREA UNDER DIFFERENT WORKING CIRCLES WITH IMPROVEMENTS IN ACCESSIBILITY

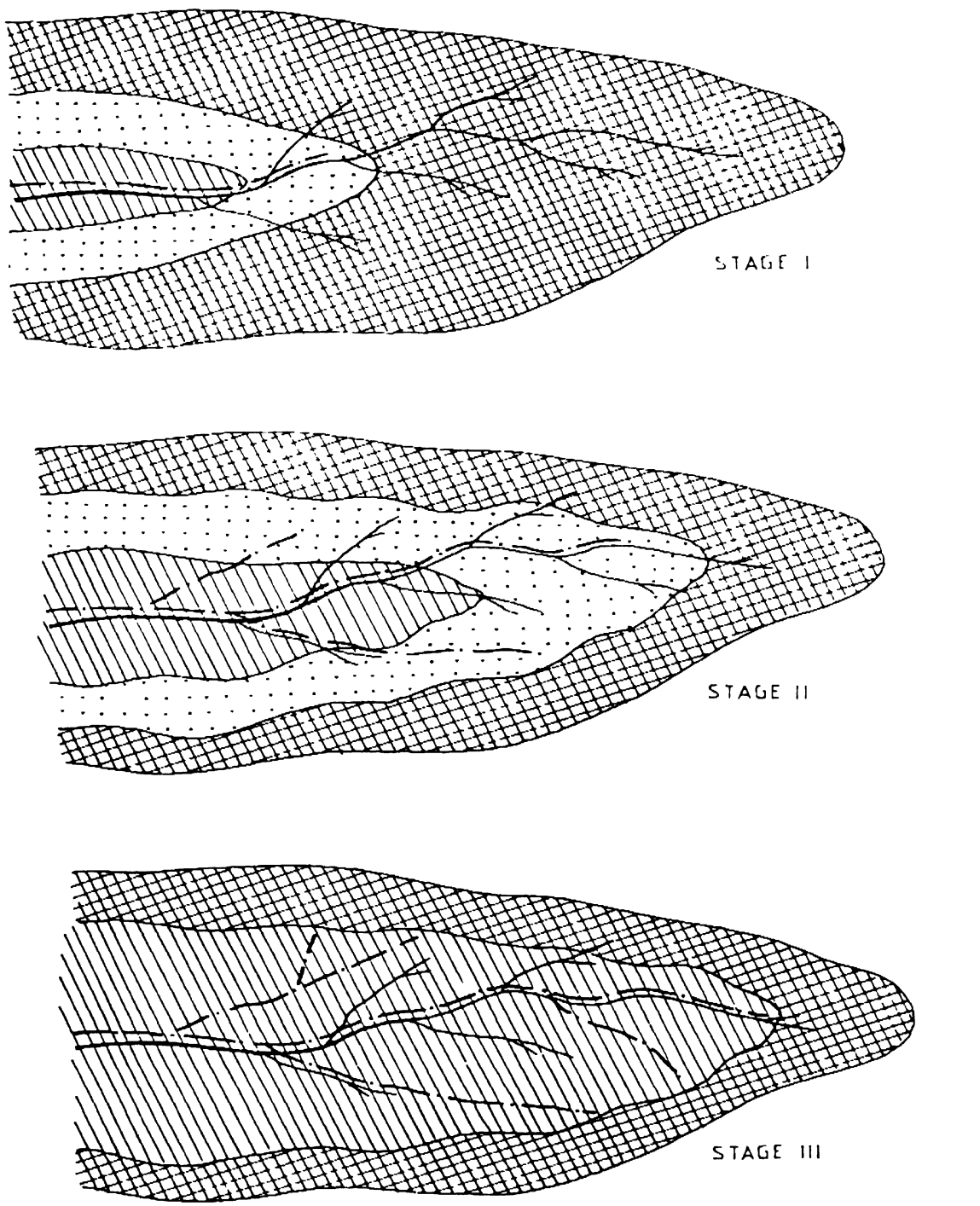
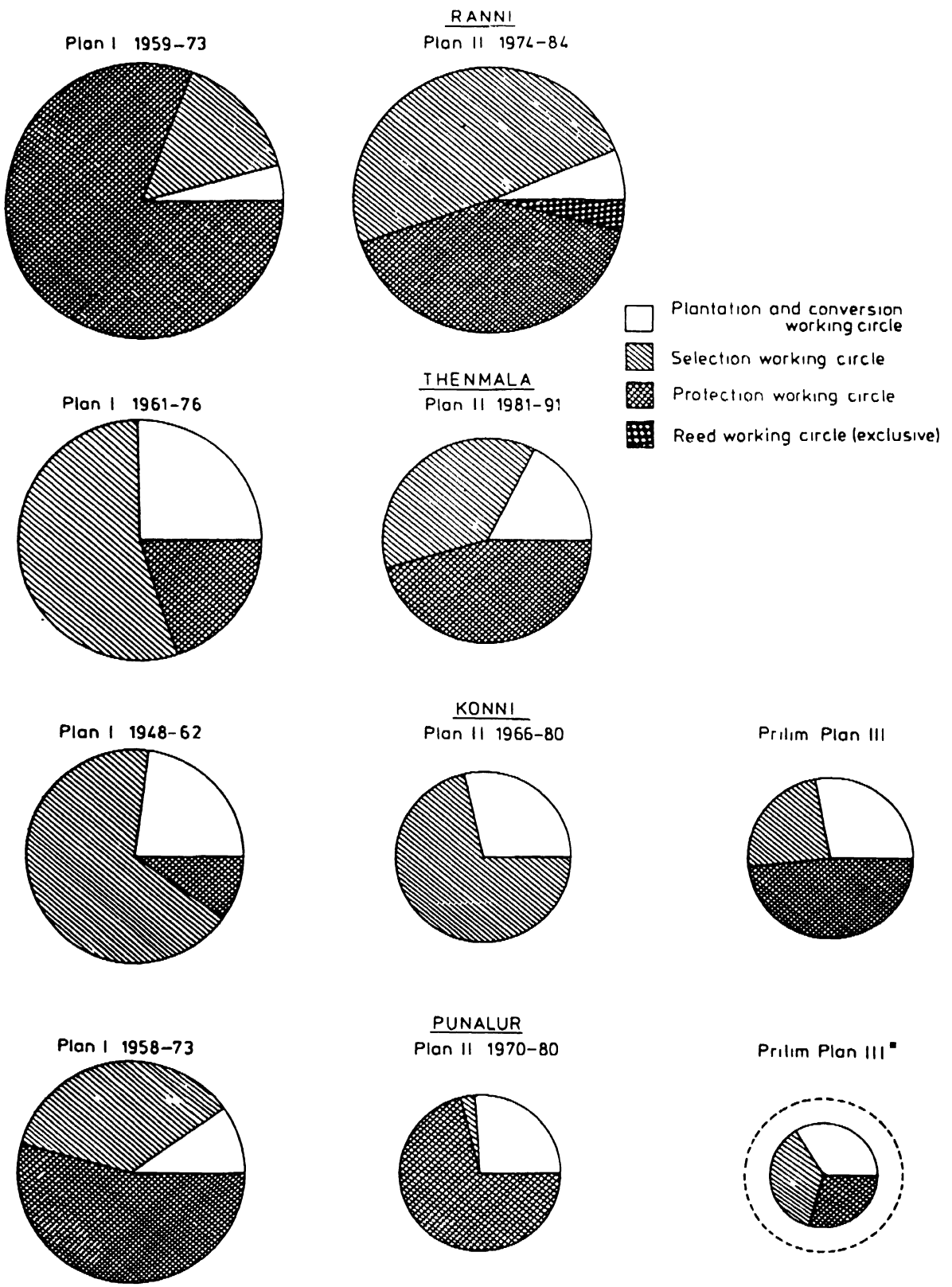


Fig 5.3

CHANGE IN THE DISTRIBUTION OF AREA UNDER DIFFERENT WORKING CIRCLES



* The ring bounded by the dotted line denotes the area leased out to public sector corporations

Although the general trend is for a movement from protection to selection (e.g. plan I to plan II, Ranni; plan I to plan II, Konni) and then from selection to conversion, very often a reverse movement to protection is noticeable in some cases (e.g. plan II to plan III, Konni; plan I to plan II, Punalur). After selection felling if land is found unsuitable for any sustainable use it reverses to the protection working circle. This could also happen if accessibility has not developed sufficiently.

It is, therefore, clear that zoning areas for the purpose of wood production and watershed protection are based on short-term priorities while characteristics influencing watershed values are not given due consideration.

5.5.2 Wood Production and Production of Non-wood Products

Simultaneous use of the same area for production of wood and non-wood products is possible only under low intensities of management. Availability of minor forest products such as honey, wax, resins, tannins, gums and medicinal plants is attributable to diversity in the composition of evergreen forests ant the multiplicity of products obtainable from the same species. Selective felling resorted for wood production does not bring about an immediate and drastic change in species composition. At low intensities of management wood production and production of canes, reeds, minor forest products, etc. can co-exist requiring no zoning. Working circles dealing with production of minor forest products, rattans, reeds, etc. therefore overlap other working circles.

However, when management is intensified to realise a higher output of any one product, it adversely affects production of other items. This is illustrated by the use of forest land for cultivation of cardamom. Intensive cultivation of cardamom requires maintaining optimal shade conditions through removal of most of the middle storey and some of the top storey trees. Weeding and cultural operations practised inhibit natural regeneration of commercially valuable species. Once an area is utilised for cardamom plantation timber production can be ruled out completely.

At present no attempt is made to cultivate reeds and management is aimed at harvesting existing natural growth. Reed being a primary coloniser in the evergreen forests, intensive management for enhancing production of reeds and wood could be incompatible. Under natural conditions reed growth gradually gives way to evergreen species. However, anthropic disturbances, particularly fire, tend to perpetuate reeds inhibiting the colonisation of evergreen species.

Rattans are generally found in dense evergreen forests and thrive well under shade. No attempt has hitherto been made to cultivate them intensively. One cannot therefore make an assessment of the compatibility between production of rattans and wood.

5.5.3 Watershed Protection and Collection of Minor Forest Products

When collection of minor forest products is carried out at a low intensity, it remains compatible with watershed protection. Therefore, even in areas grouped under protection working circle, minor forest products collection is permitted. At higher intensities of extraction watershed values are adversely affected. Intensive soil working practiced for cardamom cultivation enhances soil erosion and diminishes watershed values. Fire caused intentionally or unintentionally by reed collectors and workers engaged in MFP collection also has similar effects. Extensive tracts of evergreen forests in the study area have been burnt and this will enhance the erosion considerably.

5.5.4 Wood Production and Other Values

Recreational and wilderness uses of forests in the study area are negligible. Potential users can be categorised into two broad groups, namely rural and urban. The former forming the majority are too close to the forest to realise its recreational and wilderness values. Most of the recreational visits to forests are made by urban groups. Their unfamiliarity with the forest environment adversely affects their ability to perceive changes arising from modifications.

Evergreen forests between Plappilly and Pamba are intensively utilised for camping by pilgrims to the Sabarimala temple during the months of December and January. About 5 to 6 million pilgrims travel through the area every year and many of them camp in the forests alongside the road. Extensive areas have been cleared for providing basic amenities resulting in the destruction of forests in the vicinity (KFRI, 1979). A number of temporary shops come up during the pilgrimage season to cater to the needs of pilgrims. All such constructions utilise locally collected material, such as poles, twigs and leaves, and this has degraded the forests considerably. Fire accelerates the process of retrogression and in the long run realisation of other protective and productive values will be in jeopardy.

5.5.5 Inter-temporal Compatibility

Hitherto the discussion was centred on compatibility between diverse uses and the resolution of incompatibilities. Since sustained yield is the basic tenant of forest management, intertemporal incompatibilities have been ignored in the actual management. However, in practice, forests are not always managed on sustained yield principle and therefore it is necessary to consider the long-term implications of present management practices. Sustained yield management implies establishing a normal forest so that harvesting is limited to the increment, maintaining the growing stock intact. The basic question therefore is whether the current practices help to achieve normality and to realise a sustained yield.

Attainment of normality requires proper care and attention to the crop at different stages of its growth. Two necessary conditions for attaining normality are: (1) limiting extraction to the normal extent, and (2) achieving regeneration equal to the area or extent of extraction. As discussed earlier, regeneration aspects have been completely neglected and vast areas subjected to selection felling remain untreated. The so-called selection system practised now is oriented towards mining existing forests to meet immediate wood requirements. The high present yield is secured from hitherto unexploited areas. Therefore there is no guarantee that future yields would be of a similar magnitude. Wood production can be maintained in the second and subsequent felling cycles by: (1) avoiding the patches felled during earlier working, (2) lowering the exploitable girth, and (3) felling those left out during the previous cycles. Even these options can secure only successively reduced yields.

Natural regeneration of commercially important species depend upon the frequency of seeding and quantity and viability of seeds produced. Ground conditions such as light, soil moisture, thickness of leaf litter, and inter- and intra-specific competition affect regeneration. Phenological aspects - especially the occurrence of good seed years - of many of the evergreen species are yet unknown. The general composition of evergreen forests in the Western Ghats is such that no single species dominates the top canopy. Generally seeding is poor and erratic. Adverse ground conditions such as insufficient light, thick humus, and competition from under-storey species inhibit germination and growth. Natural regeneration is therefore very poor and cannot be relied upon to restock felled areas.

Attempts on enrichment planting taken up under the different schemes have not been successful. Firstly, the technique of regeneration has not been perfected to suit the diverse local conditions. Secondly, the area covered each year accounts for a small fraction of the felled area and the backlog increases over the years. Availability of funds and managerial and supervisory input are factors critical to the expansion of the area under regeneration. Success of regeneration depends to a great extent on intensive care in the early stages. It is doubtful whether investment required for this will be forthcoming. Financial constraints also dictate against the expansion of technical cadre in the department. All these coupled with the uncertainty regarding future demand for species now regarded as important complicate decision-making.

Therefore, one has serious doubts about the sustainability of the selective felling system practised in the evergreen forests. Two scenarios exist as regards future management of the evergreen forests. If it is assumed that whatever area now included under selection remains constant and the present practices are continued, yield obtainable at each successive felling will register a decline and before long the structure and composition will be altered to such an extent that practically no yield will be available.

Under the other and probably the more likely scenario, selection working is a passing phase and would ultimately lead to more intensive systems such as clear-felling and artificial regeneration. With improved accessibility the present trend of shifting boundaries of working circles will persist and all easily accessible areas will be converted into plantations. Protection working circle will be restricted to inaccessible ridge tops which cannot be utilised for wood production.

While discussing the future of evergreen forests, a major threat that has to be reckoned with is the diversion of land for non-forestry purposes, especially agriculture. Most of the accessible valleys along rivers and stream banks have been utilised for agriculture. Population growth and absence of non-agricultural opportunities to enhance income are bound to increase the pressure on forests.

In the light of past experience, the evergreen forests that remain are expected to decline in extent and deteriorate in quality. In the absence of a firm commitment on the part of the government to conserve the resources and to draw up policies and programmes in forestry and allied sectors, short-term economic compulsions will influence the utilisation of evergreen forests adversely affecting future benefits. The trend has been towards using evergreen forests for extensive extraction of timber for wood-based industries and railway sleepers or to produce cardamom for export. No attempt has been made to develop a sustainable system of intensive multiple-use management.

CHAPTER 6

MANAGEMENT OF MOIST DECIDUOUS FORESTS AND TEAK PLANTATIONS

A brief description of the moist deciduous forests has been given in chapter 2. This chapter discusses the management practices adopted in the case of moist deciduous forests and plantations in the study area.

6.1 Management Objectives

The principal objectives of management of the moist deciduous forests as given in the working plans are: (1) to convert the existing relatively less valuable forests into plantations of more valuable species, and (2) to obtain maximum revenue consistent with the principles of scientific forestry. Clear-felling followed by artificial regeneration with teak, eucalyptus and matchwood has been the main strategy adopted to fulfil the above objectives.

It has been pointed out earlier that teak is the most preferred species accounting for about 56 percent of the man-made forests in the study area. There are several reasons for this preference. Firstly, it is one of the best all-purpose constructional timber with multivarious uses. It yields very good decorative veneers and plywood. Secondly, teakwood has a steep price increment curve and is an ideal species to fulfil the objective of revenue maximisation. Thirdly, it is an indigenous species which comes up quite satisfactorily and has no serious pest or disease problems. And finally, the technique of raising teak is extremely simple and the investment requirements are low. All these factors make teak a favoured species and even matchwood plantations of Bombax, Ailanthus, etc. are raised with an admixture of teak. Often, the proportion of teak is so high that the nomenclature 'matchwood plantation' is a misnomer.

6.2 Organisation

Working plans dealing with management of moist deciduous forests and teak plantations sometimes identify two working circles namely: (1) conversion working circle, and (2) plantation working circle. Conversion working circle usually includes all those which are earmarked for clear-felling and planting during the working plan period. All plantations raised during the previous plans are allocated to the plantation working circle. Very often, no separate plantation working circle is identified, and all areas converted in the past and proposed for conversion are included under the conversion working circle. Conversely the plantation working circle may include areas proposed for conversion. As in the case of evergreen forests, residual areas not included in the conversion working circle are allotted to the protection working circle. Although no timber extraction is carried out in such areas, collection of minor forest produce and extraction of bamboo are permitted.

The principal objective of management in respect of areas included under teak conversion working circle, as evident from the name, is to convert the natural mixed forests into plantations of teak during a specific period known as conversion period. Management also involves operations such as tending, weeding and thinning to promote healthy growth of plantations. Salient features of the different operations undertaken in the teak working circles (conversion and plantation) are discussed below.

Typical moist deciduous forest in Achencovil Valley. See the profuse growth of bamboos.

Moist deciduous forest on hill tops. Due to fire the predominant undergrowth is grass. On ridge tops the trees are generally stunted.

6.3 Management of Teak Plantations

Conversion to teak cannot be accomplished under selection or coppice systems, and hence all teak plantations in the State are raised adopting the clear-felling system followed by artificial regeneration. Natural regeneration of teak is poor and cannot be relied upon to restock clear-felled areas and hence the need for artificial regeneration.

Important operations involved in raising teak are: (1) harvesting the existing tree growth, (2) planting and early care, and (3) maintenance of plantation till harvest.

6.3.1 Rotation and Annual Planting Area

In the study area teak is primarily grown to produce high quality construction timber and veneer logs. The rotation has to be, therefore, fairly long. In Ranni, Konni and Punalur Divisions the rotation fixed for teak is 70 years. In the current working plan for Tenmala Division, the rotation has been reduced to 60 years. Factors that influence the decision on rotation are discussed later. Once the rotation is fixed, the area that has to be planted up annually is determined as:

$$a = \frac{A}{R} \quad \text{where}$$

a = annual area to be planted

A = total plantable area

R = rotation

Attainment of normality and equal annual yields require planting of equiproductive areas every year. This has a number of practical constraints, especially on account of the difficulty in estimating the site quality before hand. Yield regulation on the basis of even equal annual areas has not been possible and is very difficult in practice. The age class distribution of existing teak plantations shows a preponderance of younger age gradations, indicating an increase in the area planted up annually. Several factors have contributed to the acceleration in the rate of conversion. Improved accessibility, especially after the Second World War, has facilitated timber extraction from vast areas and this enabled conversion of extensive forest tracts. During the 1960s and the 1970s forestry development was equated with large-scale plantation programmes and this also accelerated the rate of conversion creating abnormality in age class distribution.

6.3.2 Timber Extraction

Removal of tree growth is the first stage in the preparation of land for planting. This commences about 1 to 2 years prior to planting and is carried out in two phases. During the first phase all trees of valuable species of and above 120 cm gbh are marked, felled, converted into logs and transported to the depots of the forest department. In addition, teak and rosewood billets (tops and lops) are also collected. The work is entrusted to logging contractors on the basis of competitive tenders. Timber and firewood brought to the depots are sold in auction at periodic intervals depending upon market demand and the stock available in the depot.

During the second phase all the residual tree growth along with the lops and tops of trees felled earlier are sold in auction on a lump sum basis. The purchaser is permitted to remove all material down to a girth of 30 cm at the thinner end. As per the existing provisions of the contract, the purchaser should slash-fell the left over growth, spread them evenly in the area and burn them completely before handing over the area back to the department.

The quantity of timber and firewood obtained on account of clear-felling is extremely variable depending upon the stocking. In moist localities generally the growth is good, and there the yield will be about 80 m^3 of timber and 120 m^3 of firewood per hectare. Where growth is poor the yield may be as low as 40 m^3 of timber and 80 m^3 of firewood.

6.3.3 Technique of Artificial Regeneration

Experience gained by the department during the last many decades has enabled the standardisation of teak planting technique. Regeneration is carried out by planting stumps obtained from one-year old nursery grown seedlings. Practices currently adopted in raising the planting stock, site preparation, planting and after-care are discussed below.

6.3.3.1 Nursery Technique

Teak flowers between June and September and fruits ripen from November to January. Seeds (fruits) are collected in the months of January and February. Supply of seeds to the different divisions is undertaken by the Silvicultural Research Officer. A number of seed stands is being maintained for this purpose. In Kerala, planting stock is usually raised in temporary nurseries located close to the regeneration area. Nursery site preparation involves digging the soil to a depth of 30 to 40 cm and formation of standard beds of 15 x 1 m raised and supported with wooden stakes, split bamboos and sometimes reeds. The timing of sowing is dictated by the onset of pre-monsoon showers during April to May. Usually 4 to 5 kg of seeds (1 300 seeds/kg) are dibble-sown in a standard bed. No pre-treatment is carried out in Kerala. Germination percent varies from 60 to 80. One standard bed will be able to supply adequate number of stumps for planting and subsequent casualty replacement in an area of 0.5 hectare. The seeds germinate in about two weeks. As the regular monsoon commences within about a month, no watering is done. The seedlings are allowed to grow in the beds for a year. Stumps or root-shoot cuttings are prepared by pulling out the seedlings and trimming the stem and the root. A stump consists of 2 to 3 cm of the shoot portion and about 15 to 20 cm of tap root with a collar thickness of 1 to 2 cm. The top of the shoot portion is cut with a slant to prevent water stagnation on the cut surface and subsequent rot.

6.3.3.2 Site Preparation and Planting

As pointed out in section 6.3.2 the purchaser of residual tree growth hands over the area after burning the debris left at the site. Burning is the most effective means of slash disposal and it reduces weed growth. It also enhances the initial growth of the plants. No conclusive information is available on the effect of burning on long-term growth of teak. The fact that soil erosion and run-off accelerate in the short run cannot be denied, especially since no contour bunding is practised.

After burning, the area is aligned and planting points are marked by bamboo or reed stakes. The espacement currently adopted is 2 x 2 m. Planting is done after the onset of pre-monsoon showers in May. The stumps are planted in holes made by a crowbar. The soil around the stump is compacted to prevent water stagnating in the holes. Most of the stumps start sprouting in about 3 to 4 weeks.

On account of the high cost of weeding, taungya cultivation is resorted to in all teak plantations during the first two years. Immediately after planting, the plantation is divided into blocks of 8 to 10 hectares and the right to cultivate the area is leased out to cooperatives or individuals. Rules have been formulated to allocate the area to

cooperatives stipulating eligibility, lease, rent, etc. When no cooperative society is prepared to take up the area for taungya cultivation, the right to cultivate is auctioned out. The lessee, whether a cooperative society or individual, has to execute an agreement which contains the various conditions that regulate the cultivation. Maintenance operations such as weeding, tending, fire protection and casualty replacement are carried out by taungya cultivators. Under the earlier system, paddy and tapioca were cultivated during the first and second year respectively. Sometimes depending upon the interval between paddy and tapioca cultivation, a crop of pulses was also being taken. Currently in most areas tapioca cultivation is being permitted in both the years. When tapioca is cultivated only one stem cutting is permitted to be planted in between 4 teak plants.

Lease rent for taungya varies depending upon: (a) accessibility, (b) soil conditions, (c) availability of labour, (d) expected damage from wild animals, and (e) expected price of tapioca, etc. Market price of tapioca depends on the price of other commodities such as rice and the demand from industrial users particularly starch manufacturing units. In the study area lease rent for two years varies from Rs. 500 to Rs. 1 500 per hectare and Rs. 1 000 can be taken as an average figure. Taungya cultivation reduces the cost of plantation establishment considerably. When the lease rent is also taken into account, the cost becomes almost negligible. Where taungya is not possible, three weedings per year are carried out during the first and second year. Usually during the third year, a teak plantation is weeded twice.

6.3.3.3 Post-planting Operations

Usually by the third year teak plants grow tall enough to be free from weed competition. However, in areas where maintenance has been neglected in the early stages of establishment, weed growth will be very profuse and occasional weeding will be required even after the third year.

The cost of raising and maintaining one hectare of teak plantation till the rotation age with and without taungya is given in Table 6.3.

Table 6.3

Cost of Establishment and Maintenance of Teak Plantation

(in Rs./ha)[1/]

Year	With taungya	Without taungya
1	750	1 550
2	Nil	800
3	500	500
4 to 69	20	20

1/ Based on the wage rates applicable during 1982

Second year teak plantation with tapioca.
Very often tapioca overtops the teak.

A plantation raised under taungya

6.3.4 Thinning

A closer spacing of 2 x 2 m (2 500 plants/ha) is adopted at the time of planting to ensure that all the available space is effectively utilised and to prevent site degradation due to exposure. Since the objective of management is to produce large-sized timber, thinning becomes an essential operation. Thinning cycle, intensity and nature of thinning, etc. have been more or less standardised for teak. In the study area thinning is carried out at the 4th, 8th, 13th, 20th and 44th year. Since dominance based on crown characteristics cannot be determined in the early years, the first two thinnings are systematic or mechanical. During the first mechanical thinning stems in alternate diagonals are removed reducing the number of plants to 1 250 per hectare. Where growth is poor the first thinning is deferred to the 8th year. In the second mechanical thinning, the number of stems per hectare is further reduced by 50 percent, to 625, removing all stems in alternate rows.

All subsequent thinnings are selective and the rules adopted for this are as follows.

1. Thinning should be carried out in such a way as not to create permanent openings in the canopy.

2. All healthy and dominant trees should be retained and thinning should commence by removing the dead, dying, suppressed and dominated trees.

3. Competition from trees of other species interfering with the growth of teak should be reduced by pollarding or felling the trees of miscellaneous species. Those which are not interfering with teak may be retained ensuring sufficient space for the development of teak trees.

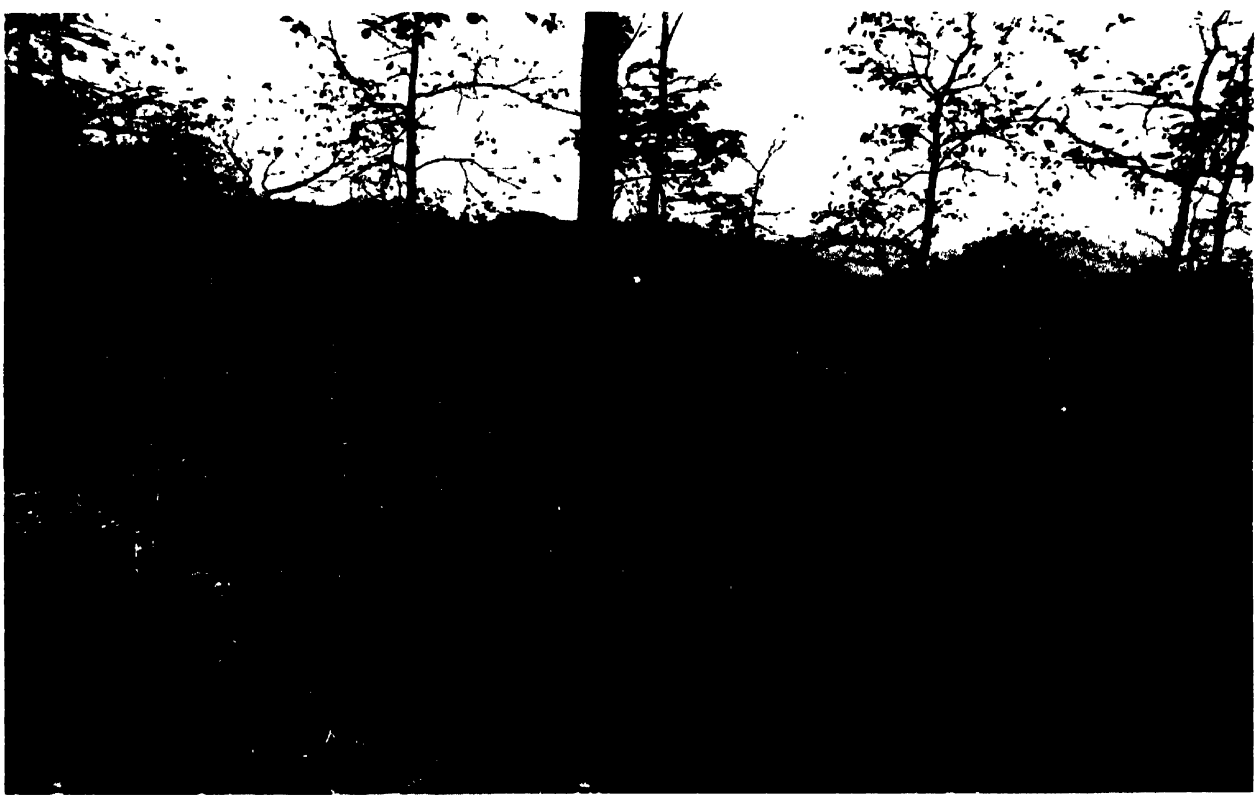
4. Mistletoe (Dendrophthoe falcata) infested branches should be cut and the parasite should be destroyed by burning. Thinning is carried out with reference to the All India Yield tables. Yield tables give the diameter/number/age relationship for different site qualities of teak. The general thumb rule applicable during early stages of the plantation is that the spacing should be about one-third of the average height. All thinnings are to be carried out before the end of November to facilitate the disposal of thinned material before the fire season.

6.3.4.1 Yield from Thinning

Being an all purpose timber, thinned materials have a ready market. Yield obtained from selected plantations in Konni Division during thinnings is given in Table 6.4.

Teak poles, irrespective of class, have a large number of uses. Class V poles are primarily utilised as scaffoldings in construction and to some extent as telephone and telegraph posts. Class IV and class III poles are used for low tension power transmission. Class II and class I poles are used for high tension lines. With concrete poles becoming more popular the demand for teak poles for power transmission may decline. Timber and small billets are used primarily in furniture making.

A middle-aged teak plantation in Konni Division. Poles collected from thinnings are stacked along the road side.



A 35-year old teak plantation in Achenkovil Division

Table 6.4

Yield from Thinning

Age	Yield (m^3/ha)		
	Poles	Timber	Total volume
4	0.439	..	0.439
8	2.646	..	2.646
13	4.381	0.005	4.386
20	6.865	0.180	7.045
30	7.328	1.591	8.919
44	7.808	4.610	12.418
Total	29.467	6.386	35.853

6.3.5 Final Felling

6.3.5.1 Rotation

Rotation is fixed on the basis of the objectives of management. Teak is an all purpose timber and even poles obtained during the first mechanical thinning are saleable. Its principal uses are in high quality construction and in the production of decorative veneers and plywood. On account of the steep price/size gradient for teak logs, in all the good quality areas such as Konni and Thenmala, teak is grown as a long rotation crop.

While fixing the rotation for teak the general trend has been to follow what was adopted in the case of Nilambur plantations. In all the divisions in the study area, except Thenmala, the rotation adopted for teak is 70 years. This is regarded as a technical rotation aimed at obtaining trees of over 57.3 cm diameter (180 cm girth) at breast height. From table 6.5 it can be seen that only in the case of first quality areas a rotation of 70 years gives the maximum number of trees above the exploitable diameter. In the case of third and fourth quality areas even at the age of 80, none of the trees would have attained the exploitable diameter, while in the case of second quality only 25 percent of the trees alone reach the prescribed size.

Table 6.6 gives the rotation of maximum volume production for the different site qualities.

Based on the total volume (stem wood + small timber) the rotation of maximum volume production varies from 5 to 15 years for the different site qualities. Taking stem wood volume alone into account, the mean annual increment culminates at the age of 50 and 75 years for first and second qualities respectively. For the third and fourth quality areas stem wood mean annual increment culminates after 80 years.

Table 6.5

Crop Diameter and Percentage of Trees Above the Exploitable Diameter of 57.3 cm

Age	Site quality			
	I	II	III	IV
50	55.4 (36)	39.9 (2)	26.4 (0)	17.0 (0)
60	60.7 (59)	45.0 (4)	30.0 (0)	19.0 (0)
70	65.3 (80)	49.3 (8)	33.3 (0)	20.8 (0)
80	69.8 (88)	53.8 (25)	36.8 (0)	22.9 (0)

Source: FRI & C (1970) Figures in parentheses represent the percentage of stems above the exploitable diameter

Table 6.6

Rotation for Maximum Volume Production (Age in Years)

Category	Site quality			
	I	II	III	IV
Stemwood and small timber	5-10	5-10	5-10	15
Stemwood	50	75	80	80

Source: FRI & C (1970)

It would thus appear that fixing 70 years as the rotation is not entirely based on technical requirements or maximum stemwood volume production. When teak planting commenced on a large-scale, the objective was production of large-sized timber. The demand for poles was limited and thinnings did not yield any income. This situation has changed and improved marketability of low diameter poles and small wood enabled the department to earn a substantial income from thinnings. In Thenmala Division the rotation has been brought down to 60 years and further reduction in future cannot be ruled out.

6.3.5.2 Yield

Average yield per hectare obtained during final felling from teak plantations in Konni Division is as follows:

1.	Timber	88.68 m^3
2.	Teak billets	47.79 m^3
	Total	136.47 m^3

Openings created in teak plantations during thinnings very often permit the growth of a number of other species, particularly Lagerstroemia microcarpa, Xylia xylocarpa, Terminalia tomentosa, and T. paniculata which are the natural associates of teak in moist deciduous forests. When final felling is carried out these yield some quantity of timber and firewood. From the study area the out-turn from such natural growth is estimated as 10 m^3 of timber and 2 m^3 of firewood.

6.3.5.3 Total Yield and Mean Annual Volume Increment

The total yield actually obtained from thinnings and final felling for plantation in Konni Division during a rotation of 70 years is 172.32 m^3 per hectare which gives a mean annual volume yield of 2.46 m^3. Data on out-turn of stemwood and small timber for different quality classes at a rotation of 70 years as given in the yield tables is furnished in Table 6.7.

When actual yield is compared with the yield table figures, it can be seen that teak plantations in Konni, which are considered as the best in the study area are generally below the All India Quality Class III. The low total yield is primarily due to low output during thinnings. Actual thinning yield/ha from all the thinnings is only about 35.853 m^3 or about 24.4 percent of the expected yield from a Class III quality plantation. However, yield from final felling approaches the out-turn indicated for Class III quality areas and is short by about 7 percent only. Poor stocking seems to be an important reason for the disproportionately low yield from thinnings.

6.3.6 Economics of Teak Plantations

Land, labour for raising nursery, planting out and maintenance and material inputs such as teak seeds, fencing materials, ropes and bamboo stakes are the major inputs involved in raising teak plantations. The costs involved in establishment and maintenance are given in Table 6.3. Land value has to be estimated on the basis of the opportunity cost, i.e. the benefit forgone on account of utilising it for raising teak plantation. Often it is pointed out that an opportunity cost is irrelevant for forest land as forests declared as reserves are not available for non-forestry purposes. In such situations an opportunity cost has to be estimated on the basis of alternatives available within forestry. The without plantation alternative involves retention of moist deciduous forest intact. This would

Table 6.7

Yield from Teak Plantations

Site quality	Yield (m^3/hectare)			MAI (m^3/ha)
	Thinnings	Final felling	Total	
I	279.884 (45.9)	330.263 (54.1)	610.147 (100.0)	8.716
II	219.359 (48.7)	230.904 (51.3)	450.263 (100.0)	6.432
III	146.589 (50.0)	146.589 (50.0)	293.178 (100.0)	4.188
IV	54.228 (38.4)	87.114 (61.6)	141.342 (100.0)	2.019

Figures in parentheses give the percentage to total volume.

Source: FRI & C (1970)

generate an entirely different stream of net benefits. However, problems involved in quantifying some of such benefits make it difficult to estimate the correct opportunity cost. Currently the forest department charges an annual rent of Rs. 650/ha for the land leased out to other agencies. For the present study this is taken as a reasonable approximation of the opportunity cost.

Out-turn of wood from thinnings and final felling has been given earlier. Income from this at 1982 prices is given in Table 6.8.

In conventional economic analysis, the stream of costs and benefits is discounted to facilitate comparison of present values of the various alternatives. Although the rationale behind using a positive discount rate in social cost benefit analysis has been subjected to severe criticism (Price, 1975; Nair, 1981), it continues to be a standard approach in investment analysis. The dispute is usually on what rate to be adopted. Guidelines and manuals dealing with cost-benefit analysis (UNIDO, 1972; Squire and Van der Tak, 1975) point out that the social discount rate should be prescribed/derived by the central planners and in the absence of such indication ....' the analyst can pick a rate such as 8-10 percent ....' (FAO, 1979). Since the objective of the present study is primarily to give an indication of the net discounted revenue, an interest rate of 5% is used here. Net present value of the with and without taungya alternatives is given in Table 6.9.

Table 6.8

Income from Teak Plantation

(In Rs./ha)

Year	Cost[1/]	Income	Net Income
4	150.00	256.00	106.00
8	300.00	2 610.00	2 310.00
13	650.00	4 820.00	4 170.00
20	1 000.00	8 940.00	7 940.00
30	1 400.00	13 280.00	11 880.00
44	1 600.00	26 320.00	24 720.00
70	12 450.00	317 300.00	304 850.00

1/ This includes the cost of felling and conversion into logs, poles and billets.

Table 6.9

Net Present Value of One Hectare of Teak Plantation

(In Rs.)

Alternative	Cost	Benefit	NPV
Without taungya	15 685.65	22 466.91	6 761.26
With taungya	14 124.05	23 446.91	9 322.86

Even without taungya a teak plantation yields a high net present value. Taungya enhances profitability on account of the reduction in maintenance cost and yielding a revenue by way of lease rent. Discounting has only a negligible effect on costs and benefits that accrue during the first few years. However, taungya cultivation with tapioca leads to site deterioration (Alexander et al., 1980). Its ultimate effect on future growth has not been quantified. Even if such information is available, as long as discounting is adopted, it will have only a negligible effect on the net present value.

A social cost-benefit analysis would require: (1) estimation of the social value of measurable costs and benefits, and (2) quantification and evaluation of changes in non-wood products and benefits. Incidence of costs and benefits among different socio-economic strata of the population also needs to be estimated and appropriate weights have to be assigned. Raising a teak plantation by clear-felling an existing moist deciduous forest drastically alters the product composition. Though a large quantity of ordinary construction timbers such as irul (Xylia xylocarpa), venteak (Lagerstroemia microcarpa), anjili (Artocarpus hirsutus) and maruthy (Terminalia paniculata) is made available through clear-felling, their future availability is adversely affected. Conversion to teak may thus have adverse distributional effects. Output of minor forest products is also affected. Although no detailed analysis has been carried out taking into account all the above aspects, prima facie it would appear that the net social benefits would be far lower than what is indicated by a financial profitability analysis.

6.4 Matchwood Plantations

The important matchwood species raised in plantations in the study area are Bombax ceiba, Ailanthus triphysa and Euodia lunu-ankenda. The total area of matchwood plantations in the study area is 5 714 hectares.

6.4.1 Management Practices

The technique of raising matchwood plantations is very similar to that of teak. Most of these are raised in intimate mixtures with teak and the latter sometimes accounts for about 75 percent of the total plants per hectare. When grown in mixtures with teak the spacing adopted is 2.5 x 2.5 m with matchwood species occupying the alternate planting points in alternate rows. When planted as a pure crop the espacement is 4 x 4 m. Weeding and maintenance operations are carried out as prescribed for teak. Two thinnings have been prescribed at the 8th and 13th years. During thinning, teak trees are to be removed so that ultimately the mixed plantation becomes a pure matchwood plantation. Where matchwood plants have not survived thinning is done selectively as in the case of a pure teak plantation.

The rotation fixed varies from 30 to 40 years and it is expected that this will be enough to obtain an average girth of 150 cm. No yield table has been prepared for Bombax or any other matchwood species.

6.4.2 Current Status

Although the matchwood plantation programme was initiated with the laudable purpose of providing wood to the match industry, this objective has not been achieved. Performance of the various species has been far from satisfactory. Since Bombax was not attempted as a plantation crop earlier, the department was reluctant to undertake pure plantations and hence the admixture of teak. This, however, generated other management problems. Rate of growth, branching habit, light requirements, etc. of the two species are different. In good quality areas Bombax grows very fast whereas in poor quality areas it tends to be suppressed by teak. Most of the matchwood plantations have become pure teak plantations. Instances of satisfactory performance by matchwood species, particularly Bombax, are exceptions.

Another species which has become quite popular now is Ailanthus triphysa and is being planted widely by agencies such as the Kerala Forest Development Corporation. This species is also grown in the farm lands and homesteads in Kerala and most of the small-scale match units in the State obtain their wood supply from the farm lands.

A matchwood plantation, predominantly consisting of Bombax ceiba.

6.5 Multiple-Use Management in Teak Plantations

At low intensities of management, mixed moist deciduous forests yield a number of benefits, direct and indirect, quantifiable and non-quantifiable. Intensification of management as envisaged through conversion into teak plantations, no doubt, enhances wood production, but has a detrimental effect on other values. The scope for multiple-use in teak plantations is discussed in this section.

6.5.1 Multiple-Use of Natural Forests vs Teak Plantations

(a) Minor Forest Products: Sustained availability of minor forest products such as honey, wax, resins, tanins, gums and medicinal plants depends on maintaining plant diversity. Teak plantations raised as monoculture tamper with diversity, drastically affecting the yield of minor forest products. No quantitative data is however available on the decline in out-turn.

(b) Wildlife: Hitherto no studies have been made on the effects of converting natural forests to teak plantations. Moist deciduous forests support a diverse fauna and this is primarily attributable to the floristic diversity. Changes in habitat conditions affect food availability and shelter with adverse consequences on wildlife.

(c) Recreation: From the recreation point of view a pure teak plantation is far less attractive than a natural mixed forest. Especially the deciduous nature of the species contributes to its undesirability.

(d) Stream Flow: No studies have been carried out on the effect of teak plantations on stream flow. The process of raising plantation enhances run-off and thereby changes the pattern of flow. On the other hand deciduous nature of teak helps to conserve moisture due to reduced transpiration. However, leaf shedding exposes the soil enhancing evaporation losses. It is difficult to quantify the net effect of all these processes.

6.5.2 Multiple-Use of Teak Plantations

Currently multiple-use of teak plantations is limited to the cultivation of food crops such as hill paddy, tapioca, etc. in the interspaces under the taungya system in younger plantations and growing of pepper vine, cocoa, medicinal plants, etc. in mature plantations.

6.5.2.1 Taungya Cultivation

(a) Origin. Taungya system was started in 1856 in Burma to channelise shifting cultivation for raising forest plantations. The system was adopted in India in the 1910s. In Kerala the practice of raising forest plantation with the help of taungya was first attempted in 1915 in Konni Division. This, did not succeed due to various reasons. The first successful plantation under taungya was raised in 1922 in Konni Division. Thereafter, taungya became a standard practice for raising teak plantations. The land was leased out to individuals or cooperative societies who undertook all works including clearing the land, burning, aligning, staking, planting and maintenance for 18 months. Seedlings were supplied by the forest department. In addition to meeting all other costs of raising teak plantations, the taungya cultivators also paid a lease rent of Rs. 10 to Rs. 37 per hectare. Hill paddy (rice) was the principal crop cultivated in the taungya areas. Introduction of taungya reduced the cost of establishment considerably. The success of taungya system in

Konni Division is attributed to the suitability of forest lands for hill paddy cultivation and the existence of cultivators close to the forests.

(b) Present Status. Along with the advent of large-scale man-made forestry, especially from 1960 onwards, a perceptible change occurred in the pattern of taungya cultivation. Earlier taungya cultivation was being carried out by small farmers and the landless in plots seldom exceeding one hectare. Large-scale plantation forestry found this system unsuitable primarily on account of the difficulty in supervising the work of a large number of cultivators. In certain areas it was sometimes difficult to lease out the area on account of poor communication facilities, non-availability of labour, etc. These difficulties were overcome by attracting investors by offering large parcels of land and introducing auction system. Plantations are divided into blocks of 8 to 10 hectares. Cultivation in such large blocks could be undertaken by large cultivators, who practice taungya almost entirely with the help of hired labour. This shift has, however, led to a change in the nature and pattern of cropping. Since the contractors are interested in maximising profits, soil exhausting crops like tapioca became the mainstay of taungya cultivation. Earlier the practice was to grow hill paddy during the first year and tapioca during the second year, with an interim crop of pulses like horsegram. On account of the low product prices and high input costs, particularly labour, paddy is not being cultivated now and in most taungya areas two successive crops of tapioca are raised.

Although tapioca is an important staple food, taungya cultivators sell the product to bulk consumers, especially starch manufacturing units. The contribution of tapioca from taungya areas to the food basket is, therefore, not very high.

A major problem associated with tapioca cultivation in forest areas is its effect on soil erosion. Taungya leases are given in May-June, and the heavy soil working coupled with high rainfall during the South-West monsoon that sets in immediately enhances the erosion hazard. This has been a major factor contributing to site deterioration.

(c) Costs and Benefits. Financial costs and benefits from taungya cultivation are shown in Table 6.10.

(d) Discussion. Despite the high financial profitability of taungya there is an increasing awareness of its negative effects especially when tapioca is used as the principal crop. However, the department is in a dilemma. In the absence of taungya, expenditure on weeding and maintenance of plantations tends to be quite high for which there are financial constraints. When plantations are not leased out for taungya, usually they tend to be neglected and weedings are seldom carried out on time. Taungya is thus regarded as a means for keeping the area weeded. Since its deleterious effect on site and subsequent effect on growth and volume production have not been quantified, it cannot be said that the benefits outweigh the costs.

One alternative would be to go back to the traditional taungya, permitting only one crop of rice. Hill paddy cultivation requires very little soil working and since rice does not grow very tall, paddy taungya is unlikely to have any adverse effect on the growth of teak. But paddy cultivation is financially less attractive, especially when profit maximisation is the objective. Subsistence cultivators will be prepared to take up paddy cultivation. However, under the land scarce situation in Kerala, this could create a number of socio-political problems. Cultivators are sometimes keen to settle down permanently in taungya areas. There are instances where seedlings of plantation species have been deliberately damaged to facilitate the continued use of land for

agriculture. Departmental taungya as being practised in certain other states could be a better alternative. However, this has a number of institutional and financial constraints. All these would indicate that taungya with tapioca is likely to continue in Kerala despite its deleterious effects.

Table 6.10

Costs and Benefits of Taungya Cultivation

Item	1st year Rs.	2nd year Rs.
1. Costs (per ha)		
(a) Lease rent	1 000.00	...
(b) Labour cost	2 000.00	2 000.00
(c) Material cost	400.00	400.00
	3 400.00	2 400.00
2. Benefit income/ha[1/]	6 000.00	4 800.00
3. Profit	2 600.00	2 400.00

1/ Average yield per hectare is 15 tons during the first year and 12 tons during the second year. The farm gate price of tapioca is taken as Rs. 400 per ton.

6.5.2.2 Inter-cropping in Older Plantations

(a) Origin and Current Status. The climatic and edaphic conditions in some of the plantations, especially those established along river banks, are ideal for growing a variety of agricultural crops. Many of the teak and matchwood plantations adjoin well-managed homestead farms supporting a mixture of perennial, annual and seasonal crops. This indicates the potential for raising an inter-crop under teak plantations.

Planting of pepper and cocoa in teak and matchwood plantations was, first attempted in 1976-77 under the five-year plan scheme 'Development of Minor Forest Products'. The 'Vanalakshmi Plantation Programme' is a continuation of the above scheme under a new name. The scheme envisaged the cultivation of cash crops such as pepper, cocoa and medicinal plants as an under-storey crop. The total area taken up under the scheme is 287 ha as given in Table 6.11.

Under-planting is taken up in plantations where final thinning has been carried out. To permit more sunlight, a 'D' grade thinning is undertaken. Teak trees are used as standards for pepper and the space in between is used to grow cocoa and medicinal plants.

Pepper grown under the Vanalakshmi Programme in the 1964 matchwood plantation in Thenmala Division

Intensive cultivation of pepper in homesteads

Table 6.11

Vanalakshmi Scheme in the Study Area as on 1.4.1982

Division	Area (ha)
Ranni	40
Konni	127
Thenmala	120
Punalur	...
Total	287

Source: compiled from the Forest Department Records

(b) Expenditure Income and Profitability. Expected pattern of cash flow from one hectare of plantation is given in Table 6.12.

Table 6.12

Expenditure and Income for Vanalakshmi Programme

(Rs./ha)

Year	Expenditure	Income
1	4 180.00	...
2	3 250.00	...
3	3 750.00	...
4	3 350.00	...
5 - 25	3 250.00	12 500.00

Source: Nair, P.N. (1980)

The internal rate of return of the project has been estimated as 15 percent and hence the venture has been judged as commercially viable. It is also pointed out that the scheme requires no additional land, but increases the productivity of existing land. In addition it enhances employment opportunities and increases foreign exchange earning through production of export crops such as pepper and cocoa.

(c) Expected vs Actual Performance. The present condition of the Vanalakshmi plantations is not very satisfactory. Stocking and growth of pepper vines and cocoa are very poor except in the Achencovil plantations in Thenmala Division. Being a deciduous species teak does not provide adequate cover to cocoa plants, particularly during summer. Casualty of cocoa is very high on account of this. Yield from the pepper vines is negligible. Expenditure on the scheme and the income realised hitherto from plantations raised in the study area are given in Table 6.13. Even if it is assumed that the income realised in 1981-82 is entirely from the plantation raised in 1976-77, average income per hectare is only about Rs. 70, far below what was anticipated. Due to its unsatisfactory performance the department has now shelved the programme.

(d) Discussion. No doubt the scheme is financially, socially and economically attractive. Technically it is possible to grow cash crops in mixtures with tree crops and this has been clearly demonstrated by peasants who cultivate the land adjoining some of the plantations. The difference in performance is attributable entirely to institutional factors, especially the difference in ownership. Intensive use of land requires not only a large dose of inputs but also personal supervision. In the case of departmental ventures supervision is lacking, whereas the small farmer attends to every individual plant. Further, inflexibility of the departmental rules impedes timely execution of various operations while the small farmer faces no such constraints. Maintaining the productivity of land at a high level is crucial to the survival of the small peasant, whereas, it is not so as far as the department is concerned. All these have been responsible for the failure of Vanalakshmi Plantation Programme.

6.6 Treatment of Unconverted Areas

As in the case of evergreen and semi-evergreen forests, areas unsuitable for conversion due to inaccessibility and adverse terrain conditions are grouped under protection working circle. Nevertheless, such areas form part of overlapping working circles and extraction of minor forest products, bamboos, etc. is carried out. As and when accessibility improves there is a tendency to convert these also into man-made forests. Future management of the unconverted areas will depend upon a number of factors, particularly population pressure, demand for wood and wood products and government's dependence on revenue derived from the forestry sector. Three options available within the framework of forestry in respect of future management of the remaining moist deciduous forests are: (1) to convert them into teak or other plantations, (2) to retain the forests as such to yield non-wood benefits, and (3) to remove a few trees under a selection felling system. Implications of these options are discussed below.

1. Conversion of moist deciduous forests into teak plantations is being justified in terms of its positive effect on government income. Immediate revenue is enhanced by clear-cutting existing forests. Long run revenue increases by way of sale of timber and small wood obtainable from thinnings and final fellings. However, one pertinent question is whether forest management should be entirely directed at revenue maximisation ignoring the temporal and spatial externalities. Almost all areas ideally suited for conversion into teak have been already clear-felled and planted. The edaphic and topographic conditions in the unconverted areas does not permit good growth of teak. Raising teak in such areas may not be advantageous; on the other hand adverse effects on non-wood benefits could be substantial.

Table 6.13

Income and Expenditure Statement of the Vanalakshmi Scheme in the Study Area[1/]

Year	Area under plantation (ha)	Expenditure Rs.	Expenditure per ha Rs.	Revenue	Revenue per ha. Rs.	Profit (+)/ loss (-) per ha - Rs.
1976-1977	35.06	38 181	1 089.02	...	...	- 1 089.02
1977-1978	35.06	10 827	308.81	...	...	- 308.81
1978-1979	35.06	10 915	311.32	...	...	- 311.32
1979-1980	81.28	163 807	2 015.34	...	...	- 2 015.34
1980-1981	191.52	474 853	2 479.39	580	3.03	- 2 476.36
1981-1982	247.32	487 479	1 971.05	2 433	9.84	- 1 961.21

1/ Excluding 40 hectares of plantation raised in Ranni Division.

Source: Records of the Forest Department.

2. Retention of forests as such in a relatively undisturbed state would no doubt contribute to non-wood values. This would however require immediate stoppage of clear-felling. Two major consequences of such an option are: (a) an immediate and drastic reduction in revenue to exchequer, and (b) diminished supply of raw-material to industries. Decision-making would therefore require an assessment of whether the non-wood values are more than adequate to compensate the above costs. Quantification and evaluation of non-wood benefits are serious problems in making a rational decision. The argument in favour of complete protection is that if clear-felling continues at the current rate, almost the entire moist deciduous forests will be exhausted in the near future and the revenue and employment benefits being realised now will cease. A decision to stop clear-felling now would therefore at least help to conserve species diversity, although this option may require sacrifice of immediate income.

3. Adoption of a selective felling system is being proposed as a via media. Augmenting natural regeneration and fire protection would help to maintain the mixed character of forests facilitating both wood production and realisation of non-wood benefits. Technically selective system is feasible but it will require more information on the growth rate and performance of important moist deciduous species under different conditions. Apart from the technical problems financial and institutional constraints could be serious. Success of regeneration in moist deciduous forests will entirely depend upon the efficiency of fire protection. Effective fire protection requires a network of fire lines, watch towers and a communication system involving substantial investment. Further to minimise fire hazard during critical periods, operations such as timber extraction, minor forest produce collection and reed extraction may have to be suspended. Social and economic acceptability of these options need to be examined.

To summarize, the question whether to convert the remaining natural forests into plantations or not is not entirely a technical question. There are a number of social and economic issues which can be clarified only with reference to a clearly drawn up forest land use policy. In the absence of such a policy, short-term options tend to be favoured compromising long-term benefits.

An alternative to teak is to raise plantations of other species both indigenous and exotic. Eucalyptus is an important exotic species being planted extensively in the study area. Large-scale plantations of eucalyptus have been raised primarily to meet the demand from the pulp and paper industry. When compared to teak, eucalyptus wood fetches a low price, whereas cost of establishment and maintenance is substantially higher than that of teak. No attempt has been made hitherto to evaluate the economic, social and environmental costs and benefits of eucalyptus cultivation.

There are a large number of indigenous species such as irul (Xylia xylocarpa), venteak (Lagerstroemia lanceolata), maruthy (Terminalia tomentos), anjili (Artocarpus hirsutus), etc. which come up naturally in the moist deciduous forests. However, very little information is available on the silviculture and management of these species. No data is available on the rate of growth and rotation. Such technical constraints coupled with uncertainty regarding future demand have led to their total neglect.

6.7 Teak Plantations

Opportunities for intensification of management in teak plantations have not been fully utilised. It is possible to introduce zonation based on site quality, accessibility, etc. so that requirements of the different end users can be met more economically. Veneer

and saw log production can be undertaken in good quality areas while poor quality areas can be utilised for production of teak poles. In the latter case rotation can be lowered to 30 or 40 years.

Despite the long history of teak management in the State, no serious attempt has been made to increase productivity through generic improvement. Attempts are being made recently to improve planting stock by collecting seeds from selected seed stands. Breeding for better form, shape, crown and disease and pest resistance should be a major area of thrust. Enhanced productivity realisable from genetic improvement could more than compensate the loss on account of reduction in the pace of conversion. Diversification through introducing miscellaneous species in teak plantations needs further attention. Introduction of agricultural crops is unlikely to be successful on account of the fact that these crops require intensive care. Existing institutional framework is inadequate to manage a multicrop system intensively. This is evident from the performance of the Vanalakshmi scheme undertaken in the area. It is, however, possible to introduce other hardwood species, and this is best done by raising mixed plantations. No doubt, management of mixed plantations is more complex than monocultures, but they are ecologically more stable and ensure a better utilisation of the site potential. Research on silviculture and management of mixed plantations should get a high priority.

6.8 Summary and Conclusions

Management of teak plantations has a long history in the study area. Initially plantations were raised on a smaller scale, primarily due to: (1) lack of adequate infrastructure to raise and maintain the plantation, and (2) low demand for timber and fire wood made available from clear-felling. When constraints imposed by accessibility and demand disappeared, large areas began to be taken up for conversion. Since contractors are engaged for timber extraction, the department did not have to shoulder the organisational and institutional problems. However, establishment of large-scale plantations and their maintenance generated new problems. Taungya system was resorted to overcome problems of high maintenance costs and non-availability of labour. But this did not provide an entirely desirable solution.

Conversion of moist deciduous forests into teak plantations has adversely affected the realisation of several non-wood benefits. The contribution of the former towards non-wood values seems to be substantial when compared to the latter. Although teak plantations yield a very high net present value, the trade-off between wood and non-wood benefits on account of changing the composition has not been worked out due to methodological problems.

Attempts at intensive multiple-use management have not been quite successful. Both the taungya system as practised now and the Vanalakshmi programme have failed to fulfil the objectives. A critical evaluation of management now adopted highlighting the constraints is given in the next chapter.

CHAPTER 7

CRITICAL EVALUATION OF FOREST MANAGEMENT

Salient features of existing systems of management adopted in the case of evergreen forests and teak plantations in the study area have been dealt with in the previous chapters. A critical evaluation of management involves a review of performance and assessment of shortfalls, if any. The reasons for defaults when present have also to be enquired into.

7.1 Targets vis-à-vis Performance

Table 7.1 indicates the broad functions tropical forests can perform. The relative priority assigned to each of these functions in the national forest policy and the management plans is also given in Table 7.1.

The National Forest Policy of 1952 does not include functions such as conservation of genetic diversity, protection of wilderness values, etc. as important policy objectives. Partly this is due to the fact that these values of tropical forests were not clearly understood at the time of formulation of the present forest policy. However, even working plans written recently do not consider these functions as objectives of management. Important objectives identified in the working plans are given below:

1. Watershed protection
2. Wood production to meet industrial demand
3. Production of non-wood products such as bamboos, reeds, canes, minor forest products, etc.
4. Revenue to exchequer

It is necessary to examine the extent of achievement in respect of the different objectives and whether conflicts between different uses are being resolved in accordance with the priority indicated above.

7.1.1 Watershed Protection

Being a non-marketed benefit, achievement/shortfall in respect of watershed protection cannot be quantified easily. Maintenance of natural forests helps to preserve the watershed values. Utilisation of forest land for agriculture involving clearance of tree growth and cultivation of annual and seasonal crops, as has happened in a number of localities in the study area, adversely affects the watershed values. None of these transfers has been based on land capability studies, but were the result of socio-political pressures. Inappropriate agricultural practices have also contributed to erosion problems.

Fire is another important factor which enhances soil erosion. Fire prevention and control are indispensable to realise watershed values. In the study area fire is an annual phenomenon. The forests are ravaged by fire several times during the summer months. The money and manpower utilised for fire protection is a clear reflection of the low priority assigned to this. Of the annual expenditure on various forestry operations only 0.3 percent is expended on fire protection. Even this is utilised entirely for clearing fire lines around young plantations and temporary forest depots where timber and poles are stacked.

Table 7.1

Objectives of and Priorities in Forest Management

Functions	Ranking given in the national forest policy and the working plans				
	National Forest Policy	Working Plans			
		Ranni	Konni	Thenmala	Punalur
1. Watershed protection	1	1	1	1	1
2. Conservation of genetic diversity	**	**	**	**	**
3. Wildlife protection	*	*	*	*	*
4. Wilderness value	**	**	**	**	**
5. Recreation	*	*	*	*	*
6. Wood production to meet local demand	*	*	*	*	*
7. Wood production to meet industrial demand	2	2	2	2	2
8. Production of MFP	*	*	*	*	*
9. Revenue to government	3	3	3	3	3

* Denotes an objective not explicitly stated but indicated as a function

** Not considered as a function either explicitly or implicitly

Changes in the area under protection circle in successive working plans indicate that watershed protection is not given a high priority. Selection felling carried out in evergreen forests, it is asserted, causes minimal disturbance to the ecosystem and enables the maintenance of watershed values. Selective logging is however not an outcome of the conscious effort to reconcile the conflict between watershed protection and wood production, but dictated by commercial considerations, particularly accessibility of the area and demand for the species. If watershed protection is being given a high priority, some of the evergreen and moist deciduous forests on steep slopes, particularly at Chembala, Mullamala, Kallar Valley, Veluthode, should not have been clear-felled. Not only that the natural forests in these areas were clear-felled, but also that after reforestation with teak and matchwood the plantations were leased out for taungya cultivation accelerating soil erosion. Damage by way of soil loss from areas where tapioca is cultivated is very serious (Alexander et al., 1980). Thus, although watershed protection is listed as a high priority objective, in practice it gets a low priority.

7.1.2 Wood Production

Unlike watershed protection, achievement/shortfall in respect of wood production can be easily monitored. The trend in production of timber and firewood from the study area for selected years between 1956-57 to 1981-82 is given in Table 7.2. It can be seen that from 1956-67 onwards there has been an upward trend in output reaching a peak in 1973-74. Thereafter a marginal reduction is noticed in production.

Table 7.2

Out-turn of Timber and Firewood from the Study Area

(in m^3)

Year	Timber	Firewood
1956-57	10 398	5 678
1958-59	39 032	17 626
1960-61	48 469	32 170
1962-63	73 458	71 462
1964-65	85 829	120 940
1966-67	128 934	117 270
1968-69	110 586	155 476
1970-71	165 216	153 928
1972-73	217 978	346 996
1974-75	147 530	104 678
1976-77	175 443	175 506
1978-79	126 655	112 922
1980-81	198 113	139 516
1981-82	83 230	154 772

Source: Administration Reports of the Kerala Forest Department

Up to 1960-61 production was low in comparison with later periods. Enhanced production from 1961-62 onwards is due to clear-felling for raising plantations and to make land available for other purposes. During the period 1965 to 1982, 14 933 hectares were cleared for non-forestry purposes, while 16 543 hectares were cleared for raising forest plantations. Construction of the Kallada Irrigation project and the Sabarigiri hydro-electric project necessitated clearance of tree growth in the submergible area. Land required for various state-owned corporations such as the State Farming Corporation, Plantation Corporation of Kerala, Rehabilitation Plantations, Oil Palm India was also made available by clearing forests in the study area. Sustainability of wood production depends on how the logged over areas are utilised. Selection felling of evergreen forests and clear-felling of moist deciduous forests account for about 80 to 90 percent of the wood output. Poor regeneration in evergreen forests would seriously affect future wood production, particularly affecting the plywood industry.

Reforestation with teak in moist deciduous forests alters the product composition drastically. The choice of teak is primarily based on commercial and silvicultural considerations and no attempt has hitherto been made to examine its long-term economic implications. Once most of the moist deciduous forests are converted, supply of non teak timber will decline and this may reduce the existing high premium on teak. Already there are some indications of this change. The distributional effects could also be significant on account of the shift in production from ordinary quality construction timber to high quality teak wood.

Currently, wood production is primarily aimed at meeting regional or national demand and no arrangement exists to meet local needs. Benefits derived by people living in villages adjacent to forest areas are limited to occasional seasonal employment in logging, plantation establishment, tending, thinning and taungya cultivation. Seasonal unemployment and unsatisfied demand for wood, particularly fuelwood, have led to large-scale illicit felling. This is usually treated as a law and order problem and countermeasures involve increasing the number of forestry personnel and providing them better facilities to tackle offenders.

To conclude, in the short run wood production objective is fulfilled primarily through selection felling in evergreen forests and clear-felling of moist deciduous forests. Long run output of wood will depend upon: (1) area that is permanently retained as forests and (2) the success of regeneration in these areas. The former depends on the socio-political environment, while the latter on institutional, technical and financial factors.

7.1.3 Revenue

Policy statements give a low priority to the objective of revenue maximisation, but in practice it is not so. Clear-felling of moist deciduous forests and selective felling in evergreen forests generate the major part of the forest department's revenue. Plantations are very often raised not due to their positive contribution to future wood production, but as a concomitant to clear-felling natural forests undertaken with the objective of enhancing revenue.

Thus, at the implementation stage priorities get reversed and wood production and revenue maximisation come to the top. Objectives such as production of minor forest products, protection of wildlife, if at all fulfilled, are accomplished incidentally and no effort is made to manage forests to enhance these benefits. Conservation of genetic diversity, and protection of wilderness areas are not considered as relevant objectives at all. Thus there is considerable divergence between the theory and practice of forestry, especially when it involves management for realisation of multiple benefits. The reasons for this are discussed in the next section.

7.2 Constraints in Multiple-Use Management

Although contradictions in the theory and practice of forestry in tropical regions are well-known (Leslie, 1977) reasons for the same are less well understood. How a resource such as forests is utilised will depend upon the objectives and outlook of the owner. Management objectives in the case of private ownership are easy to identify. Under public ownership the objectives are less precise and are amenable to influence from forces that control government. Existence of a plural society differentiated on the basis of caste, class, ethnicity, socio-economic status, etc. complicates forest management primarily due to differences in the nature of demand from these groups. Forest policies are most often formulated without a realistic assessment of the situation. This leads to divergences between policy statements and practice which in turn affects forestry institutions giving rise to technical and financial constraints. These aspects are examined below.

7.2.1 Socio-political Environment

Population pressure and increasing demand for forest products influence decisions on forest land use and management. Population is a heterogenous assortment of groups with different demands on forests and hence the question of what types of demands will be met and to what extent becomes relevant. On account of the diverse needs of different groups, forests in the study area have to satisfy mutually conflicting demands. These demands may be for: (1) land (landless cultivators, tribals, wood-based industries, government and other organisations), (2) products (industries, households, traders, etc.), (3) income (government, households, etc.), (4) employment (households), and (5) services (agriculturists, urban population, tourists, etc.). The different types of demand which the forests have to cater to and the source of such demands are shown in Fig. 7.2. Differences in demand give rise to competitive or complementary relationship between groups of people. If meeting the requirements of any one group adversely affects other groups the relationship is competitive. A compromise is however possible when demand is limited in relation to availability. Complementary relationship develops when the interests of different groups coincide. A good example of this is the demand for land by electricity board, irrigation department, state-owned corporations, etc. with the demand for veneer logs by plywood industry, revenue for government, timber to traders and employment for local wood cutters. Clearance of forests to meet the demand for land releases a large quantity of timber to industries and traders. Incidentally, this enhances government income and provides temporary employment to local people in logging.

The demand for tangible goods, particularly products and land, may be limited or unlimited. Competition between two groups becomes intensive when both have unlimited demand. Demand for land by encroacher cultivators, pulp and paper industry and forest-based corporations is unlimited while that by public utilities such as electricity board and irrigation department is limited. A group with unlimited demand for land would regard its allotment to another as a reduction to its potential availability. Competitive relationship exists between traditional and modern industries requiring the same products. For example bamboo and reed are the most important input in traditional industries such as basket-making and mat-weaving which provide livelihood to some of the economically and socially backward sections in society. They also form an important long fibre raw material for the pulp and paper industry. When supply is less than demand, the relationship between different users becomes competitive. The Kerala State Bamboo Corporation which caters to the demand for reeds by the traditional sector, has been complaining about reduced raw material availability on account of allotment of reeds to the pulp and paper industry. Similarly demand for pulpwood and the resulting conversion of mixed forests to plantations tend to affect long-term availability of construction timber, firewood, medicinal plants, etc.

Several groups are interested in the protection of natural forests primarily for products and services obtainable from them. These include plywood industry (continuous supply of veneer logs), traditional industries (medicinal plants, minor forest products), tribals (maintenance of habitat), tourists (recreational and wilderness values), and low-land cultivators (prevention of floods and maintenance of stream flow). Due to the positive time preference of most of the product demanding groups, long-run effects of their own or other groups' activities remain unnoticed. Non-compliance of silvicultural prescriptions relating to the extraction of wood and other products is primarily attributable to this.

Given the conflicting nature of different demands, which of these will be satisfied and to what extent, will depend upon the relative power of each group. Power is dependent on organisational strength, economic and political clout and method employed to assert the demand. Encroacher cultivators derive their support from political parties on account of the latter's dependence on the former for votes. Existence of a large number of political parties and the fragility of coalition governments in Kerala make encroachers a powerful group. The lukewarm approach adopted by all governments and the periodic regularisation of encroachments are clear testimony to this. Public corporations primarily acquire their strength from the bureaucracy and political parties while private sector industries derive their influence from money power. The high profitability arising from subsidised raw material supply and protected markets enable them to wield considerable power, both directly and indirectly.

For a number of reasons the image of government projected as an impartial arbitrator of inter-group conflicts is misleading. Even in perfect democratic system, government represents only the interests of present generation and more often fail to protect the interests of future generations. Within the present generation governments depend upon the support of certain groups and classes and therefore has to give priority to their interests. Further, governments may have their own objectives such as revenue maximisation which will be in conflict with the objectives of other groups in society.

Based on the relative standing of each group in terms of economic power, organisational strength and method employed to assert their demands, they can be ranked as given in Table 7.2.

In the case of competitive or mutually exclusive demands the groups which stand higher in the hierarchy will have precedence over those below. A weaker group can also secure its demands if it happens to be complementary to the interests of a powerful group. The demands that will be satisfied first are revenue to government, forest produce demand of the modern industries, land for electricity board and forest land-based public undertakings, etc. Those that will remain least satisfied are the demand for services from forests, especially habitat protection, regulation of streamflow as the groups which require these wield little power. As indicated in Fig. 7.1, this socio-political environment directly and indirectly affects formulation of forest policies and programmes and their implementation.

7.2.2 Policy Constraints

A well-defined policy taking into account the social, economic and environmental conditions is a pre-requisite for efficient management of forest resources. Such a policy is yet to be formulated. In theory, the national forest policy of 1952 continues to be the basis for forestry planning in Kerala. Working plans, forest development projects, administration reports, etc. reiterate the objectives contained in the national policy. But, in reality, often this is used as a convenient facade to pursue objectives diametrically opposed to what has been prescribed.

Fig. 7.1

SECTOR WISE PRESSURE ON FORESTS : DEMAND FOR LAND AND PRODUCTS

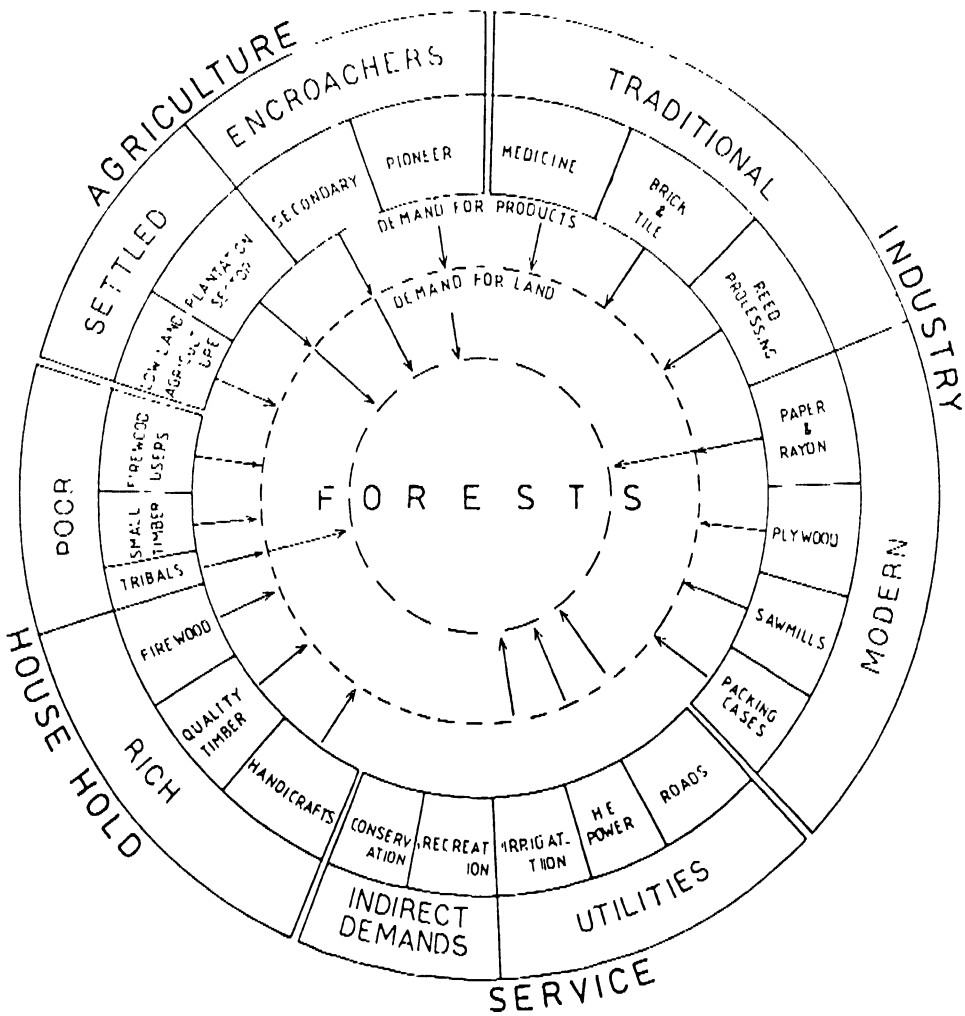


Table 7.2

Ranking of Different Groups

Rank	Groups
I	Government
II	Electricity Board, Pulp and Paper industry, Other modern wood-based industries, traders (rich)
III	Forest land-based public corporations
IV	Encroacher cultivators, highland planters
V	Traditional industries (rich)
VI	Wood users (rich), tourists (rich), traders (middle class)
VII	Traditional industries (poor), low income wood users
VIII	Lowland agriculturists, tribals

A forest policy should be closely linked to other sectoral policies particularly, agriculture, industry, energy, etc. However, there are no clear-cut policies in these sectors and this directly and indirectly affects forest management. Lack of an agricultural policy has been responsible for most of the forest encroachments and haphazard alienation of land to raise rubber, oil palm, sugar-cane, cardamom, etc. Absence of an industrial policy has led to the unplanned development of wood-based industries. When decisions on the establishment or expansion of forest-based industries are taken, long-term availability of raw material is seldom taken into account. Once industries come up, the political and economic power of management, workers and interested political parties ensure that raw material is made available whatsoever be the social costs.

7.2.3 Institutional Constraints

Management of forests to realise the protective, productive and social benefits requires appropriate institutions. At present the forest department, an arm of the government, is the only institution directly involved in the management of forests. Competence of any institution depends on the resilience of its internal structure and the ability of its functionaries. The structure determines flexibility and adaptability to changes in the external environment. Having highly qualified managerial personnel, although necessary, is not a sufficient condition for success. The vertical structure of the forest department causes considerable inflexibility limiting its ability to respond to changes. Primarily the forest department was established to fulfil two functions, namely: (1) to exercise administrative authority by policing the tracts of forest land, and (2) to organise timber extraction. Over a period of time other functions, not originally envisaged, have become important. When objectives such as conservation of

genetic diversity, protection of watershed, meeting rural needs, maintenance of recreational and wilderness values, protection of wildlife and agro-forestry are thrust upon the department, the structure that exists seems to be incapable of handling problems associated with these. New cells or sections to handle social forestry, wildlife management, etc. have been created within the existing framework. Positions in these are filled up not by those specifically trained for the purpose, but entirely by promotion based on seniority in the service.

The cumbersome procedures and regulations that field level functionaries have to observe add to the inflexibility. No work involving expenditure can be undertaken by the field staff without (1) administrative sanction, (2) budget provision, (3) estimate sanction, and (4) authorisation to draw money from the treasury. Although inflexibility of the existing system has been recognised and acknowledged by the government, instead of taking corrective measures another institution, namely the forest development corporation, was established.

Shortage in the number of field staff is another important constraint. One of the main problems in undertaking large-scale regeneration work is the lack of personnel to effectively supervise the various works. Foresters and forest guards form the most important functionaries in the field. In addition to their routine work of protecting forests from unauthorised human activity they have to supervise all the works connected with regeneration, tending, thinning, harvesting, etc. The average area under the charge of officials at different levels given in Table 7.3 indicate that their number is grossly inadequate for any system of intensive management.

Table 7.3

Area under the Jurisdiction of the Different Officials in the Study Area

(Area in ha)

	Ranni	Konni	Thenmala	Punalur	Study Area
1. Forest guard	1 667	1 228	1 494	571	1 260
2. Forester	4 040	2 073	2 580	1 556	2 719
3. Ranger	17 505	11 055	9 461	14 002	13 116
4. Assistant Conservator of Forests and Deputy Conservator of Forests	52 515	16 583	18 922	28 005	27 871

Source: Records of the Forest Department

One of the major drawbacks in existing forest management is that there is no evaluation of the various programmes and practices in relation to the objectives identified in the forest policy or the working plans. Internal evaluation carried out by the department primarily looks into whether the existing rules and regulations are being observed or not, particularly in the execution of various works. No attempt has hitherto been made for an overall assessment of the working of the department.

7.2.4 Technical Constraints

The ability of an institution to fulfil the objectives for which it has been established depends on to a great extent of its technical capability. Technical know-how enables the manager to understand the relationship between the components in the system and how they have to be manipulated to attain desired objectives. Multiple-use management aiming watershed protection, conservation of genetic diversity, recreational benefits, wood production, etc. requires technical know-how in a wide range of disciplines.

A good knowledge of the resource base - area under different vegetation types, land capability, risk of degradation, growing stock, increment, regeneration status, factors that influence regeneration, forest hydrology, plant-animal interaction - is a pre-requisite for scientific forest management. Forest managers should also have a thorough knowledge of the social and economic implications of the various management alternatives. Despite the fact that management has a fairly long history in the study area, such information is not readily available. Even as regards area under forests, the figures furnished by different government agencies are irreconcilable. Such information gaps are serious impediments to evolving socially, economically and environmentally sound management practices.

The most important constraint regarding forest management is that sufficient knowledge on forest dynamics does not exist. The long-term impact of different timber extraction techniques and silvicultural treatment on future yield, natural regeneration, etc. is not known. On account of the difficulty in comprehending the complexity of the evergreen forest ecosystem, management has been directed at extraction of marketable timber or to convert them into simple manageable systems such as monoculture plantations. Effective methods of regenerating evergreen forests are yet to be evolved. The raising of mixed plantations is another area where technical constraints and poor knowledge of silviculture impede their widespread adoption.

Research, education and training are the most important components that improve the technical know-how. In all these aspects investment is very low. Although the problem of obtaining natural regeneration has been recognised a long time ago, practically no attempt has been made to investigate the problem in its totality. Site selection for raising plantations still continue to be based on the personal judgement of the Working Plan Officer or the Divisional Forest Officer and not based on any objective criteria taking into account soil characteristics, topography, etc. Failure of plantations as exemplified in the case of localities such as Rajampara, Veluthodu, pockets in Mullumala and Chembala are partly due to faulty site selection.

Training imparted to officials at different levels continues to be outmoded. After the initial training at the time of entry into the service very few get an opportunity to update their knowledge in the whole of their career. Field staff are generally unaware of recent developments in silviculture and management. This contributes greatly to the time lag involved in putting into practice new information and knowledge. This information gap, communication gap and adoption gap have seriously hampered the development of scientific forestry.

7.2.5 Financial Constraints

Financial constraints faced in the implementation of various plans and programmes can be regarded as an outcome of the institutional constraints described earlier. Intensive management aimed at realisation of multiple benefits requires substantially higher investments than what is made now. Two major problems encountered are that: (1) the availability of funds is subjected to wide fluctuations, and (2) items of investment which yield benefits only in the long-run tend to be neglected. The pattern of allocation of expenditure among important activities in the study area for the years 1979-80 to 1981-82 is given in Table 7.4.

Table 7.4

Allocation of Expenditure on Forest Management

(in 000 Rs.)[1/]

Year	Item						
	Timber extraction	Salaries	Cultural operations	Fire protection	Regeneration in evergreen areas	Plantation and other works	Total
1979-80	135.32 (71.1)	37.33 (19.6)	2.18 (1.1)	1.23 (0.6)	0.28 (0.2)	14.08 (7.4)	190.42 (100.0)
1980-81	163.48 (67.3)	39.77 (16.4)	4.17 (1.7)	2.17 (0.9)	0.40 (0.2)	32.96 (13.5)	242.95 (100.0)
1981-82	220.63 (71.1)	47.56 (15.3)	3.80 (1.2)	1.58 (0.5)	1.88 (0.6)	35.01 (11.3)	310.46 (100.0)
Average	173.14 (69.8)	41.55 (16.8)	3.38 (1.4)	1.66 (0.7)	0.85 (0.3)	27.36 (11.0)	247.94 (100.0)

1/ Figures in parentheses give percentage of the total

Source: Records of the Forest Department

Nearly 70 percent of the annual expenditure is incurred on timber extraction. Unlike other investments, logging of natural forests has a very short pay back period and enhances government income immediately. Any reduction in expenditure on timber exploitation will have a perceptible effect on revenue. Investment on cultural operations and regeneration activities on the other hand are beneficial in the distant future and are of no immediate consequence. Similarly, benefits from protection of natural forests from fire are not evident immediately and hence tends to be neglected. Cuts in budget allotment is made up by reducing expenditure on cultural operations, regeneration and fire protection. Shortage of funds for maintenance of plantations has been one of the factors that led to the adoption of taungya system for raising plantations. Where taungya has not been possible, plantations remain unattended leading to suppression by dense weed growth.

Financial constraints arising from the existing system of allocation of funds from the general government budget have been identified as a major bottleneck in undertaking long-term forestry investment. This has been an important consideration in the setting up of forest development corporations.

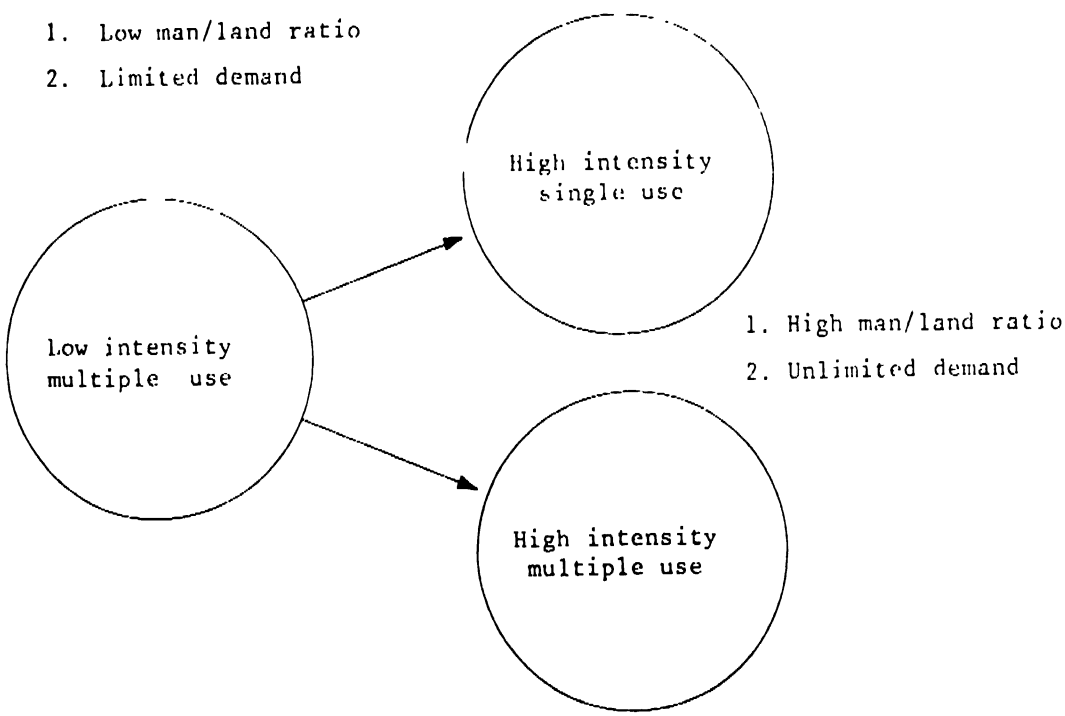
7.3 Relevance of Multiple-Use

General constraints in forest management have been briefly discussed earlier. Before concluding it is necessary to examine the scope and relevance of multiple-use management. The concept of multiple-use is not something new, but was being practised by traditional societies which derived their sustenance - food, fodder, fuel, fibre, etc. almost entirely from forests. A very low man/land ratio and limited demand for products permitted the realisation of multiple benefits even without any conscious efforts. Such a situation no more exists in the study area or elsewhere in the State. The high population density and the multitude of unsatisfied demands have necessitated intensive management. The two broad options available in this connection are indicated in Fig. 7.2. The relevant question is which of the options will be actually pursued.

The study area presents an interesting situation where different facets in the development/under-development of multiple use management are observable. Intensity of management in different forest zones in the study area is indicated in Table 7.5.

FIG. 7.2

OPTIONS IN FOREST MANAGEMENT



It would appear that protection, selection and conversion working circles represent different stages in the transition from low intensity management to high intensity management. This has enhanced production of high quality timber at the cost of other benefits. Realisation of non-wood benefits will be jeopardised if the present trend continues.

Table 7.5

Intensity of Management in Different Zones

	Forests	Working Circle	Intensity of use for production of		
			Wood	Non-wood products	Services
1.	Evergreen and moist deciduous	Protection	Nil	Low	Very high
2.	Evergreen	Selection	High	Low	Low
3.	Teak plantation	Conversion	Very high	Nil or very low	Very low

Multiple-use management does not imply the realisation of all conceivable benefits from every unit of the forest land. It should be sufficient if all the areas put together yield most of the benefits. Identifying areas for intensive wood production is therefore not contrary to multiple-use management. However, the trend noticeable in the study area or for that matter in the whole of Kerala is not this, but a gradual and perceptible shift towards uses which enhance wood production at the cost of other benefits.

This, however, does not imply that multiple-use management will always be ignored. Given the socio-economic conditions, multiple uses beneficial to powerful groups in society would be developed while those uses which are beneficial to future generations and weaker sections are unlikely to be adopted. Taungya with forest plantations is beneficial to the forest department and large farmers. Even plantations of rubber, oil palm, cardamom, etc. form components in multiple-use management in a very broad sense. But invariably they reduce the supply of conventional non-wood benefits and services affecting mostly the under-priviledged sections in society.

This raises the question of appropriateness of intensive multiple-use management. Technically it implies efficient utilisation of resources. If an area can be utilised to yield more than one benefit, the sum of which exceeds that realisable under single use, no doubt it is technically more efficient. Attention should also be focused on as to who derives the benefits from intensive practices. In a country where poverty is acute, land use should be directed primarily to meet the needs of the neediest. If that is not the case, the concept of multiple-use ceases to be socially relevant.

7.4 Summary and Conclusions

An evaluation of forest management in the study area reveals considerable divergence between prescriptions and practices. In all working plans prepared for the study area a high priority has been assigned to watershed protection, while revenue maximisation is given a very low priority. During implementation, however, these priorities change and wood production along with revenue maximisation attains pre-eminence, while watershed values are completely disregarded. Any achievement in this respect is purely incidental. Even in the case of wood production the emphasis is to satisfy immediate demand through logging natural forests. Investment aimed at maintaining long-term productivity is negligible.

Dichotomy between theory and practice can be traced to conflicts between different strata in society. In a plural society comprising of several classes and groups, divergence in the demand on forests is inevitable. These demands are either competitive or complementary, the former being more common. To what extent the demand of a group will be satisfied depends on the relative power wielded by that group. The class/group conflicts influence formulation of forest policies and their implementation.

Absence of a forest policy linked to policies in allied sectors such as agriculture, industry and energy seems to be an important constraint in the management of forests in the study area. This in turn gives rise to institutional constraints. At present forest department is the only institution directly involved in forest resource management. Being an organisation established primarily to maintain administrative authority and to organise timber supply to government, it has inherent limitations in undertaking multiple-use management. The major technical constraints arise from the imperfect understanding of the complexity of the tropical forest ecosystem and the implications of various changes. Despite the long tradition of forest management in the study area, sufficient knowledge is still lacking to enable better management. Converting natural forests into easily manageable plantations is an attempt to sidestep problems involved in managing natural forests. But this directly affects the concept of multiple-use by reducing plant diversity. Financial constraints also affect forest management. Fluctuating budget allocation and the tendency to give a high preference to investments that yield quick returns, are detrimental to the long-term existence of forests and even to sustainable wood production.

Multiple-use management is not a new concept, but was in vogue in a situation of low population density and low demand. When these conditions change, society has the option to adopt either high intensity single-use management or high intensity multiple-use management. Multiple-use is a valid concept especially in a resource scarce situation. But it should not be regarded as a panacea and before accepting, its social implications should be taken into account.

CHAPTER 8

CONCLUSIONS AND RECOMMENDATIONS

From the earlier discussion it is clear that no serious attempt has been made to manage the evergreen forests on a sustainable basis. Most of the effort is directed at extracting marketable trees from easily accessible areas. Inaccessible areas are temporarily included under protection working circle and improvement in communications results in their transfer to selection and sometimes even to conversion circles. Investment on regeneration and fire protection is extremely negligible undermining long-term yield of both wood and non-wood products and benefits.

In the case of teak plantations effort has gone primarily to extend the area. Lack of attention at the time of site selection and neglect of after-care have increased the proportion of poor quality plantations. Very often the underlying objectives of raising plantations is not to increase future output of timber, but to enhance immediate income by selling timber obtainable from clear-felling of forests on the planting site. Forestry development in Kerala has taken place on the extensive margin and attempts at improving productivity are lacking. In Kerala land is a scarce factor of production, however, policy makers treat it as an unlimited resource.

Existing management practices are mostly aimed at fulfilling single objectives - essentially wood production - and if at all more than one objective is achieved, it is incidental and not an outcome of deliberate efforts. This being the trend, whether multiple-use management has any future is a valid question. In a plural society comprising a large number of groups and classes with diverse demands, multiple-use management appears to be the only viable option. But given the strong trend towards single use, developing intensive multiple-use systems tends to be difficult. Steps that could help intensive multiple-use management are briefly indicated in this chapter.

8.1 To the Future: Pessimism or Guarded Optimism?

Forestry is one of the many sectors in the economy. Its linkage with other other sectors is both complementary and competitive. For scarce resources such as land and investment funds it has to compete with sectors like agriculture, live stock, etc. Following the adage, 'whether there will be meat in the kitchen or not will be decided not in the kitchen', developments in forestry will largely depend upon what happens in other sectors. Projections to the distant future, therefore, tend to be highly speculative. Nevertheless, such attempts help to understand the magnitude of the problems and to focus attention on crucial issues.

The high population density and the chronic unemployment and under-employment are two important factors that will have a direct bearing on land use planning in Kerala. Although the rate of growth of population shows a declining trend and is the lowest in India, it still imposes a severe strain on the economy. Based on what may happen in the agricultural and industrial sectors, two extreme, but quite probable, situations can be visualised as giben below:

Situation 1: Continuation of the Present Trade in Forest Land Use

The main features will be as follows:

(i) Growth in agricultural production will be achieved through extension of cultivation to new areas and not through improvement in the productivity of land. Improved accessibility will lead to diversion of forest land for non-forestry purposes, especially for cultivation of non-food crops such as rubber, coffee, cocoa and oil palm.

(ii) Land currently utilised for cultivation of annual and seasonal food crops will be increasingly utilised for raising perennial cash crops. This will have two effects namely: (1) the unemployment problem will be aggravated due to the fact that labour requirement for perennial tree crops like rice, and (2) dependence of the State on imported food grains will increase. Most of the rice cultivation in Kerala is practised in the densely populated lowland region, and a shift in cropping pattern will have disastrous effects. This could trigger a migration of landless agricultural labourers to the highland region. Encroachment to forest land for cultivation and illicit cutting of trees to earn a livelihood is likely to increase, resulting in severe depletion of forest resources. Any disruption of the public distribution system for want of adequate food grain supply from outside the State could pave the way for forest clearance under 'grow more food schemes' as has happened during the post-Second World War period.

(iii) Industrial development will continue in an unplanned manner and agro-based and forest-based industries, whose direct and indirect land requirements are high, will dominate the manufacturing sector. Long-term availability of wood may not be taken into account in establishing wood-using industries. This may result in accelerated deforestation.

(iv) With the growing demand - supply imbalance, large-scale industrial units are likely to put a claim on the remaining forest land under the pretext of ensuring assured and efficient supply of wood raw material. It is quite probable that this may be accepted leading to the privatisation of extensive forest tracts.

(v) With the stagnation in agricultural and industrial production, forests will continue to be an important source of revenue to the government encouraging timber extraction in order to enhance income to the exchequer.

Under the above situation, forest management will increasingly move towards single, or exclusive uses. Groups which are able to exert pressure will ensure that their requirements are given priority. All accessible areas will be utilised for single use management - for production of wood or cash crops.

However, one redeeming feature is that this trend may not continue indefinitely. The economic and environmental strains in the economy could encourage a re-examination of the whole approach at some stage or the other.

Situation 2: The Alternative

In contrast to the laissez-faire approach described earlier, situation 2 involves more rational management of resources, based on a clear understanding of the social priorities. The benefits from forests will not only accrue to all sections of society but also to future generations. The important features of this situation are as follows:

(i) Land utilised for agriculture will stabilise at present level and growth in production will be achieved by enhancing productivity of land and not through extension of cultivation to new areas. The shift in cropping pattern in favour of perennial cash crops noticeable now will be reversed.

(ii) There will be a rapid expansion of the manufacturing sector. Along with this, a shift may take place from land-dependent agro- and forest-based industries to those whose direct and indirect land requirements are negligible. Raw material supply to wood-using industries will be rationalised and those which cannot be provided a sustained supply will be phased out.

(iii) With the overall improvement in the agricultural and industrial sectors, governments' reliance on forests for revenue is expected to be minimal. This will curtail the tendency to clear forests to increase governments' income.

(iv) Forestry planning will give priority to meeting the basic needs of the population on a sustainable basis.

The two alternative paths of the economy described above will have differing implications on forestry, especially on the adoption of intensive multiple-use management. Under situation 1, the scope for multiple-use management is limited. Situation 2 provides a more congenial environment.

8.2 Multiple-Use Management: What Can be Done?

Foresters have little control over the exogenous factors that influence forestry. Under the conditions that exist in Kerala, forestry's influence on the rest of the economy is insignificant when compared to that of the latter on the former. However, this does not imply that forest managers should adopt a passive role. Given the high population pressure and diversity of demand, at some time or other intensive multiple-use management will have to be accepted as the only alternative. Both the theory and practice of multiple-use management are in an undeveloped stage. Suggesting what can be done to improve the situation is clearly beyond the scope of the present study. Nevertheless, based on Kerala's experience, some broad indications can be given. The following seems to be the priority areas for future action:

1. A clear-cut forest policy forming part of an integrated policy on agriculture, energy, industry and other sectors is an essential requirement. A clear articulation of the priorities and the magnitude of trade-offs between incompatible objectives is essential for sound multiple-use management. Policy formulation being the realm of politicians, the forest manager's role will be indirect by way of providing all the technical information to decision-makers.

2. A thorough site evaluation based on soil, topography, vegetation, slope and such other characteristics is essential. Forest land use should be based strictly on such a capability classification.

3. Areas for exclusive, primary and general uses should be identified in the field on the basis of capability classification. Land zoning should be done to accomodate mutually exclusive uses. Important zones and the uses to which they can be put to are indicated in Table 8.1.

4. Multiple-use management is technically more complicated than single-use management. Research support is essential to evolve appropriate multiple-use systems. Areas requiring immediate attention are indicated below.

   (i) Although considerable progress has been made in research on the utilisation of a large number of hardwood species found in the evergreen and moist deciduous forests, knowledge on their silviculture and management is negligible. Consequently, there is a tendency to prefer those species for which information is readily available. Practically very little is known on the management of mixed plantations. Failure of the matchwood plantations reflect the absence of knowledge on management of mixtures. There is, therefore, an urgent necessity to reorient research on the silviculture of indigenous hardwood species and management of mixed plantations.

Table 8.1

Important Zones for Forest Management

Zone	Area	Primary and secondary uses
1. Protection	Catchment areas of rivers	1. Watershed protection 2. Conservation of genetic diversity 3. Protection of wildlife and wilderness values 4. Low intensity recreation 5. Limited collection of minor forest products
2. Production	Forests on moderate slopes	1. Production of wood to meet regional and national demand 2. Cultivation of medicinal plants 3. Collection of minor forest products
3. Village	Easily accessible forests adjoining villages	1. Production of small timber fuel fodder for local consumption 2. Food, fodder and fuelwood production under agro-forestry 3. Cultivation of medicinal plants

(ii) Growth and yield statistics on most of the evergreen species are not available. Yield estimation is, therefore, largely based on assumptions. No information is available on the annual increment and how much can be removed without endangering the productivity of evergreen forests. The case study has revealed that even in two adjoining divisions with identical vegetation types, different assumptions are used as regards girth increment of trees. Growth and yield study on evergreen forests is a priority area for research.

(iii) Effect of different methods of logging on evergreen forests, especially on regeneration, is another important area for research. It has been pointed out that even when harvesting is restricted to 8 to 12 trees per hectare, felling damage is heavy. Logging methods which minimise such damages have to be developed.

(iv) Most of the evergreen forest are deficient in natural regeneration, especially of the commercially valuable species. Research has to be directed towards identifying efficient methods for augmentation of regeneration.

(v) Agro-forestry seems to be a promising system of land use under the conditions that exist in Kerala. Farmers are quite familiar with mixed cropping system, and at least in areas where soil and terrain conditions permit, this seems to be a more viable alternative than pure plantation forestry. Research is required to highlight the technical, social and economic aspects of agro-forestry.

5. Appropriate institutions have to be developed for management of forests in the different zones. Organisational pattern of the forest department has to be made more flexible to cope up with the problems involved in intensive multiple-use management. Grass root level organisations should be fostered to undertake forest management at least in areas identified for meeting local needs.

These recommendations imply a value judgement that forest management can pursue rational objectives independent of the socio-political environment. The validity of this can be criticised. But then a beginning has to be made and one cannot wait till the emergence of 'ideal' conditions.

APPENDIX I

WAGE RATES FOR FORESTRY WORKS

Minimum wage rates for different categories of forest workers have been fixed by the Government of Kerala in Notification 7899/E1/73/LB dated 1.4.1974. On the basis of terrain, distance to the nearest habitation and local availability of labour, forest areas have been grouped into ordinary, difficult and very difficult areas with different basic wage rates as given in Table A.1.

Table A.1

Basic Wage Rates for Different Categories of Forest Workers

(Wage rates/day (8 hours work) in Rs.)

Category	Ordinary area	Difficult area	Very difficult area
1. Skilled			
Felling and sawing, Workers engaged in river transport	12.00	13.50	15.00
2. Semi-skilled			
Collection of bamboo, Charcoal burning, Loading and unloading firewood and timber	9.75	10.96	12.18
3. Unskilled	7.20	8.10	9.00
Digging, Nursery work, Planting, Boundary clearing, Earth work, etc.			
4. Unskilled Women	5.70	6.42	7.13

In addition to the daily wages fixed above, the daily rated workers shall be eligible to get a variable daily allowance linked to the latest available consumer price index published by the Directorate of Economics and Statistics. The basic wage rates are linked to the consumer price index of 800. For every 5 completed points in the CPI above 800, the workers are eligible to get a daily allowance of 2.75 paise. The variable daily allowance applicable for selected periods are given in Table A.II.

Table A.II

Variable Daily Allowance for Workers

Period	Rate/day
January 1981	7.14
January 1982	8.28
January 1983	9.24
January 1984	11.76

The Government's notification also stipulates that in case an employee is actually in receipt of higher wages than the minimum wages fixed, he shall continue to get the benefit of such higher wages.

In the case of loading and unloading workers, trade unionism has enhanced their bargaining power. Some of the loading workers often earn as much as Rs. 200/day during the peak working periods.

GLOSSARY

CONVERSION: A change from one silvicultural system or species to another.

COUPE: An area that is taken up for forestry operations during a specified period, usually one year.

ENRICHMENT PLANTING: Planting of valuable tree species in degraded or naturally poor forest with a view to improve the value of the crop.

FELLING CYCLE: The interval between successive main fellings in the same area under the selection system.

FELLING SERIES: A forest area forming the whole or part of a working circle and delimited so as (1) to distribute felling and regeneration to suit local conditions and (2) maintain or create a normal distribution of age classes.

HILL PADDY: Unirrigated rice cultivated mostly in the hilly areas.

MATCHWOOD: All the species, primarily, but not exclusively, used in the match industry (splints and boxes).

MELLABHOM: Mellabhom is a system of extraction of timber under which users (particularly industries) are permitted to collect a specified quantity of timber on payment of an agreed rate. Felling, logging and transport of timber are undertaken by the purchaser. Before the logs are transported from the site, they are measured and the value at the rates previously agreed is collected (Syn.: Seigniorage, Royalty).

TAUNGYA: A system of raising forest plantations along with agriculture (Syn.: Agri-silviculture). The system was first adopted in Burma modifying the hill cultivation practised there (Taung = hill, ya = cultivation).

WORKING CIRCLE: A forest area forming whole or part of a working plan area organised with a particular objective and one silvicultural system and one set of working plan prescriptions.

WORKING PLAN: A written scheme of management aiming at continuity of policy and action and prescribing the treatment of a forest tract.

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